

## Complete Summary

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### GUIDELINE TITLE

Radiation oncology nursing practice and education.

### BIBLIOGRAPHIC SOURCE(S)

Oncology Nursing Society (ONS). Radiation oncology nursing practice and education. 3rd ed. Pittsburgh (PA): Oncology Nursing Society (ONS); 2005. 277 p. [1078 references]

### GUIDELINE STATUS

This is the current release of this guideline.

This guideline updates a previous version: Oncology Nursing Society (ONS). Manual for radiation oncology nursing practice and education. Pittsburgh (PA): Oncology Nursing Society (ONS); 1998. 79 p.

## COMPLETE SUMMARY CONTENT

SCOPE  
 METHODOLOGY - including Rating Scheme and Cost Analysis  
 RECOMMENDATIONS  
 EVIDENCE SUPPORTING THE RECOMMENDATIONS  
 BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS  
 CONTRAINDICATIONS  
 QUALIFYING STATEMENTS  
 IMPLEMENTATION OF THE GUIDELINE  
 INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT  
 CATEGORIES  
 IDENTIFYING INFORMATION AND AVAILABILITY  
 DISCLAIMER

## SCOPE

### DISEASE/CONDITION(S)

Cancer

### GUIDELINE CATEGORY

Evaluation  
 Management  
 Treatment

## CLINICAL SPECIALTY

Nursing  
Oncology  
Pediatrics  
Radiation Oncology

## INTENDED USERS

Advanced Practice Nurses  
Nurses

## GUIDELINE OBJECTIVE(S)

- To provide specific recommendations for the education of nurses new to radiation oncology and for the practice of quality radiation oncology nursing care
- To assist with the articulation of the role of the radiation oncology nurse, justification of nursing staff positions in the department of radiation oncology, and the evaluation of radiation oncology nurses' performance

## TARGET POPULATION

Adult and pediatric patients undergoing radiation therapy

## INTERVENTIONS AND PRACTICES CONSIDERED

Nursing management of the patient receiving radiation therapy (RT), including:

- External-beam
- Low dose rate/high dose rate (LDR/HDR) brachytherapy
- Prostate brachytherapy
- Accelerated partial breast irradiation
- Intravascular brachytherapy, intraoperative RT
- Stereotactic radiosurgery/RT
- Total body irradiation
- Total nodal irradiation,
- Total skin irradiation
- Hyperthermia
- Photodynamic therapy
- Concurrent chemotherapy, radioimmunotherapy and radionuclide therapy
- Radioprotectors and radiosensitizers

## Evaluation/Management/Treatment

1. Assessment of patients undergoing radiation therapy for actual or potential problems and for general, site-specific, disease-specific, and modality-specific side effects
2. Formulation of a plan of care for a patient receiving RT, including patient assessment, symptom management, teaching, defined outcomes, and evaluation criteria.

3. Teaching the patient and family about the principles and procedures of RT and its potential side effects and providing appropriate self-care measures
4. Documenting key components of the patient's care
5. Utilizing radiation safety precautions, procedures, and protocols

#### MAJOR OUTCOMES CONSIDERED

- Quality of life
- Morbidity associated with radiation therapy

### METHODOLOGY

#### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

#### DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches using Medline, CINAHL (Cumulative Index to Nursing and Allied Health), and Index Medicus. In addition, evidence was obtained through review of the Cochrane Library, Agency for Healthcare Research and Quality, and the National Comprehensive Cancer Network.

#### NUMBER OF SOURCE DOCUMENTS

Not stated

#### METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus  
Weighting According to a Rating Scheme (Scheme Given)

#### RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Hierarchy of the levels of evidence range from strongest to weakest with the strongest level being meta-analysis of multiple controlled clinical trials and weakest being opinions.

#### METHODS USED TO ANALYZE THE EVIDENCE

Review

#### DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

#### METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

## RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

## COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

## METHOD OF GUIDELINE VALIDATION

External Peer Review

## DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

The guideline document was reviewed by five field reviewers. The document was also carefully reviewed by the three editors, who are all known experts in the field of radiation oncology.

# RECOMMENDATIONS

## MAJOR RECOMMENDATIONS

### A. Principles of radiation protection

1. Time: The amount of exposure received is directly related to the amount of time spent near the radioactive source. Nurses should continue to provide needed patient care while minimizing the time spent in close contact with the patient receiving gamma radionuclide therapy, which poses a radiation exposure risk. The time limit per direct patient contact per nursing shift should be posted on the patient's hospital room door. Time limit for patient visitors also should be posted. Examples of strategies to minimize time include the following (Dow, 1992).
  - a. Provide necessary patient education before the procedure and teach the patient important self-care measures.
    1. Observe and document the patient's ability to perform self-care measures (e.g., taking routine medications, performing daily hygiene) before the procedure.
    2. Evaluate the patient's understanding of the rationale to limit nursing care, staff contact, and family visitors.
  - b. Provide the maximum amount of direct nursing care before the radioactive source is placed or administered.
  - c. Assemble all necessary equipment/supplies in the patient's room before the procedure to avoid unnecessary trips and ensure that equipment (e.g., telephone, television) in the patient's room works properly before the radioactive source is administered.

- d. Check frequently on the patient via the intercom or telephone; anticipate the patient's needs; and encourage the patient to communicate any problems or concerns to the staff via the intercom or telephone.
  - e. Use time efficiently when in contact with the patient. Nurses caring for patients with specific radioactive procedures may want to practice routine care activities (e.g., log rolling the patient from side to side, visually checking the position of the gynecologic applicator, emptying a urine Foley bag) required in an inpatient setting.
  - f. Rotate the nursing/ancillary staff caring for the patient receiving radioactive implants and reassure the family that care is a priority and the patient will not be neglected.
  
- 2. Distance: The amount of radiation exposure one receives is inversely related to the distance one is from the radioactive source (inverse square law). By doubling the distance from the source, exposure is decreased by a factor of four (two squared). For example, an exposure rate of 40 mrem/hour at one meter would decrease to an exposure rate of 10 mrem/hour at a distance of two meters (see Figure 10 in the original guideline document). The following are examples of nursing care measures that maximize distance from a radioactive source. With direct patient contact, stand as far away from the sealed radioactive source as possible. For example, stand at the head of the bed to take vital signs when in the room with a patient who has a gynecologic implant. Talk to the patient from the doorway versus inside the room (Dunne-Daly, 1997).
  - a. Assist the patient with needed tasks (e.g., unwrapping food tray items) from a distance versus next to the source.
  - b. Reinforce teaching of self-care activities at a distance from the patient.
  
- 3. Shielding: The amount of radiation exposure received from a specified radioactive source can be decreased by the use of an absorbing material (shield) placed between the source and the person receiving the exposure. The amount of exposure decreased by shielding will vary with the energy of the source and the thickness of the shielding material. Half-value layer (HVL) refers to the thickness of a material required to reduce radiation exposure to one-half of its original exposure amount. For example, the half-value layer of cesium-137 is 6 mm of lead or 10 cm of concrete. Following are common suggestions for using shielding to reduce exposure (Dunne-Daly, 1997).
  - a. Keep the shielding between the source and the person exposed. Build shields into the walls and floors of treatment rooms that are used for radioactive procedures that use high-energy gamma sources.
  - b. Continue to use principles of time and distance, even with shields, to further reduce radiation exposure.
  - c. Consider that maneuvering the shield may require increased nursing time in the room, making some uses of shields unwarranted.

- d. Select the correct material for shielding based on the type of emitters (i.e., lead for high-energy gamma sources, plastic for pure beta sources).
- e. Use more shielding in institutions that perform large numbers of gamma-emitting radioactive procedures.

## B. Radiation monitoring devices

### 1. General information

- a. Even though ionizing radiation cannot be detected by the human senses, detection devices can measure the amounts of radiation exposure received by an individual through the use of a personal monitoring device or survey monitor.
- b. Monitoring devices do not offer any radiation exposure protection. They only physically measure levels or amounts of exposure.

### 2. Types of personal dosimetry monitors

- a. Film badge: An individual monitoring device that contains a piece of a special film, which is periodically read (i.e., monthly, three times per year). The optical density of the film changes when it is exposed to ionizing radiation. An individual's film then is compared to a known amount of exposure to obtain the periodic amount of radiation exposure received. Film badges are recommended for individuals who need constant radiation exposure monitoring in the occupational setting. Film badge guidelines are as follows (Dunne-Daly, 1997).
  - 1. Badge should be worn consistently at work during the time of potential and actual exposure (should not be worn outside of work).
  - 2. Badge is not to be shared or exchanged with other staff.
  - 3. Badge should not be exposed to excessive heat or moisture.
  - 4. Badge should not remain on lab coat or placed in a room using radiation sources when not worn.
  - 5. Badge should be worn on the area of the body that the highest deep, shallow, and eye-dose equivalent is expected to be received (in general, this is on the front of the body between the waist and collar of the individual). For specialized work where the highest dose is at the head level, such as in fluoroscopy, the dosimeter should be worn at the collar.
  - 6. Badge should be read according to the institutional time schedule for readings and the cumulative record of badge readings be kept on file at the institution.
- b. Ring badge: An individual monitoring device similar to a film badge but worn on the finger that is used by personnel who are handling radioactive material. Guidelines are similar to those of a film badge (Dunne-Daly, 1997).
- c. Pocket ion chamber dosimeter: A lightweight radiation measurement instrument that gives similar readouts of radiation exposure as a film badge that individuals use who do not need continual radiation exposure monitoring but periodic

monitoring for scheduled radioactive procedures. Unlike a film badge, different personnel can share pocket dosimeters. The amount of radiation exposure received is known immediately for each person who wears the monitoring device. Pocket dosimeters are especially useful for nursing/healthcare staff and family members in contact with persons who are cared for on inpatient or outpatient units that infrequently use diagnostic or therapeutic radioactive materials. Pocket ion dosimeters should (Dunne-Daly, 1997)

1. Be left at the nurse's station or outside the patient's room with the exposure dose record sheet that keeps track of individual exposure amounts. These devices should not be kept near the radioactive source.
2. Be worn the same place as a personal film badge, where the highest dose may be received.
3. Be read before entering the patient's room and then again after leaving the patient's room and recorded on the dose record sheet. Information to be recorded includes the name of the person exposed, date, time, dosimeter readouts, time spent in the room, and reading before entering and then after leaving the room.
4. Be handled gently. If dropped, tapped, or knocked, pocket ion chamber dosimeters can show inaccurate readings and may need to be recalibrated by the radiation safety staff or radiation oncology dosimetry staff.
5. Be read by holding them up toward the light, in a horizontal position, and reading the point at which the hairline crosses the numbered scale.
6. Have their records kept on file and monitored by the radiation safety officer (RSO)/radiation protection staff.

C. Recognition of radiation-restricted areas: Federal and state laws require the posting of appropriate radiation protection warning signs in areas containing potential and real radiation exposure (National Council on Radiation Protection and Measurements [NCRP], 1989).

1. Radiation caution signs (NCRP, 1989) (see Figure 11 in the original guideline document)
  - a. Contain a yellow background with magenta lettering and should specify the specific radionuclide source and radiation precautions
  - b. Should be placed on the door of the room once a source is present and until the source is removed or until exposure risk is no longer present
  - c. May be placed as stickers on a patient's identification wristband
2. Therapeutic radionuclide information sheets
  - a. Should be placed in the patient's chart
  - b. Document radionuclide information (e.g., type of radiation, length of use, specific restrictions, emergency contacts, dislodgment precautions).

- D. Special radiation protection considerations and issues involved in specific radiation procedures
1. Yttrium-90 labeled antibody (anti-CD20 radiolabeled antibody) (Hendrix, 2004; Wagner et al., 2002); strontium-89 for painful bony metastases (Silberstein et al., 2003)
    - a. Because yttrium-90 is a pure beta emitter, administration is safely performed on an outpatient basis. Some patients need to be treated as inpatients for medical reasons, not because of radiation protection needs. Strontium-89, also a pure beta emitter, can be given as an outpatient injection (Silberstein et al., 2003; Wagner et al., 2002).
    - b. There is minimal radiation exposure risk to patients' family members and healthcare workers in contact with the patient.
    - c. Healthcare staff need to follow universal precautions. Bags, vials, and tubes that are used and contain yttrium-90 absorb any radiation that may be present.
    - d. Patients receiving yttrium-90-labeled antibodies can be discharged immediately after treatment, and no patient activity limits or dose rate limit measurements need to be taken (Wagner et al., 2002).
    - e. The person administering the radiolabeled antibody should wear gloves and use a plastic syringe cover over the radiolabeled medication and be careful to not spray or drip the medication.
    - f. Patient should be encouraged to use regular toilet facilities, avoid urine leakage, and double flush the toilet. Anyone handling the patient's urine, especially in first 24 hours post-injection, should wear gloves.
    - g. Condoms are recommended for sexual relations for one week post-injection (Hendrix, 2004).
    - h. After discharge, patients should clean up any spilled urine and dispose of any urine or blood-contaminated material (e.g., flush it down the toilet; place it in plastic bag in household trash) to prevent its being handled by others.
  2. Radioiodine-131 for thyroid cancer/hyperthyroidism (Meier et al., 2002)
    - a. In 1997, the United States Nuclear Regulatory Commission (USNRC) revised its patient release regulations, allowing for larger activities of radioactive iodine-131 to be given as an outpatient administration. Previously, the USNRC required any individual receiving 30 or greater millicuries of radioactive iodine-131 to be an inpatient in radiation isolation and discharged after an exposure rate of <5 mR (milliroentgen)/hour at one meter was obtained. The new regulation allows patients to be released if the total effective dose equivalent to any other individual is not likely to exceed 5.0 mSv (millisievert)(Grigsby et al., 2000).
    - b. Studies have shown that the amount of radiation exposure received by household members of patients discharged after receiving iodine-131 have been below the limit (5.0 mSv) mandated by current USNRC regulations (Grigsby et al., 2000; Ryan et al., 2000).

3. Iodine-125 and palladium-103 prostate seed implants (Michalski et al., 2003; Smathers et al., 1999)
  - a. Prostate implants can be done as an outpatient procedure. Once the seeds are in place, there is little radiation exposure risk to others.
  - b. USNRC guidelines allow discharge of patients if the exposure rate at one meter is at or below 0.01 mSv/hour for iodine-125 and 0.03 mSv/hour for palladium-103.
  - c. A study involving radiation exposure to family members of men who received iodine-125 seeds showed that spouses received an average of 14 mrem and other family members received less than 8 mrem over a course of one year. With palladium-103, spouses received 6 mrem and other family members essentially 0 mrem. (To put things into perspective, a person flying from New York to Tokyo receives 20 mrem, and someone flying from New York to Los Angeles receives 5 mrem.)
  - d. Discharge instructions to patients who received iodine-125 or palladium-103 vary per institution but usually include avoidance of holding young infants, young children, or pregnant women on one's lap and using a condom for several months.
4. Special radiation protection considerations: In a freestanding, non-hospital-associated facility, it is recommended that the local fire/emergency medical service (EMS)/police are aware of radiation hazards. All freestanding facilities also are regulated by NRC/state radiation control organizations.
5. Special populations: Radiation exposure of pregnant employees (NCRP, 1994)
  - a. Embryos/fetuses are the most radiosensitive living tissues.
  - b. The most radiosensitive period of a fetus is in the first trimester.
  - c. Because of the radiosensitivity of the embryo, a pregnant woman has a dose limit of 5 mSv (0.5 rem) during pregnancy per NCRP guidelines.
  - d. Many institutions recommend that pregnant women and men and women who are trying to conceive not provide care to patients who are receiving radionuclide therapy; however, by law, pregnant women cannot be restricted from providing this care, as long as NCRP guidelines for exposure limits are followed.
  - e. The pregnant woman assumes all responsibility for the exposure of the fetus until the pregnancy is officially declared. Once a pregnancy is declared, the supervisors/RSO are responsible for ensuring the pregnant woman's monitored radiation exposure does not exceed the 5 mSv (0.5 rem) dose limit. The RSO also is required to evaluate the work area and recommend further procedures to reduce exposure.
6. Emergency procedures: General guidelines for emergency procedures, including radioactive spills and loss or rupture of a sealed radioactive source, can be found in NCRP Report No. 105, Appendix A (1989).
  - a. Dislodged source guidelines

1. Notify the radiation oncologist and RSO regarding any dislodged source as soon as it is discovered.
  2. Have a lead storage container available to store any dislodged source and have long-handled forceps available to pick up the source. Only individuals with training in handling radioactive sources should be permitted to handle dislodged sources. Bare hands should never be used to pick up a radioactive source.
  3. The patient also should be instructed to never pick up a dislodged radioactive source but to immediately contact the staff if a dislodged source is suspected.
  4. The time the source became dislodged should be recorded and communicated to the radiation oncology team to determine the therapeutic radiation dose received by the patient.
  5. Radiation safety staff should survey all applicators/dressings/linen that may contain a dislodged source before removing them from the room.
  6. A patient receiving a permanent iodine-125 seed implant should be instructed to contact the radiation safety staff immediately if a seed is found dislodged. The radiation safety staff should counsel the patient regarding disposal of the seed(s).
- b. Cardiopulmonary resuscitation (CPR) of patients who have received radionuclide therapy.
1. CPR in patients with sealed radionuclides
    - a. Begin CPR immediately.
    - b. Notify someone immediately who can properly remove the sealed source and place it in a lead/safe container.
    - c. Once the source is removed and properly stored and the area is surveyed, no additional risk of exposure is present.
  2. CPR in patients with unsealed sources (iodine-131) (Health Physics Society, 2004)
    - a. Begin CPR immediately.
    - b. Notify radiation safety personnel/radiation oncologist.
    - c. Realize that the priority is the patient, and staff exposure is likely to be minimal. (Thirty minutes of resuscitation of a patient with 100 millicuries of iodine-131 would result in approximately 100 mrem exposure at one foot, 200 mrem/hour exposure rate.)
    - d. People performing CPR should wear gloves, gown, and shoe covers.
    - e. All equipment used for CPR should be surveyed for radiation contamination before removal from the room.
    - f. All personnel involved in CPR should remain in the immediate location of the patient's room and be cleared to leave the area by radiation safety personnel.

- c. Periodic in-service instruction regarding radiation protection
  - 1. Regulations require that nurses caring for patients receiving radionuclides be instructed in radiation protection measures. Some regulations require yearly in-services.
  - 2. Institutions may want to establish a competency-based, yearly radiation protection exam (see Figure 12 in the original guideline document).

E. Related web sites (Refer to the original guideline document for details)

## General symptom management

- A. General patient and family education (Refer to the original guideline document for details)
- B. Fatigue
  - 1. Pathophysiology (Refer to the original guideline document for details)
  - 2. Incidence (Refer to the original guideline document for details)
  - 3. Assessment
    - a. Screening: The presence and severity of fatigue needs to be determined. The following three questions can provide this initial information:
      - 1. Are you experiencing fatigue?
      - 2. If so, on a scale of 0-10, 0 being no fatigue and 10 being the most severe fatigue, how would you rate it?
      - 3. How has this fatigue impacted your daily life? (Piper et al., 1998)
    - b. Information should be given on fatigue management, even when fatigue is mild or absent at the time of screening.
    - c. Comprehensive assessment
      - 1. Objective data
        - a. Medical history
        - b. Review of systems
        - c. Physical examination
        - d. Laboratory values: complete blood count (CBC), electrolytes, additional testing as appropriate
      - 2. Subjective information
        - a. Severity and pattern of fatigue
        - b. Effects on mood
        - c. Ability to concentrate
        - d. Exacerbating factors
        - e. Cultural issues
    - d. Fatigue assessment tools
      - 1. The Oncology Nursing Society (ONS) fatigue scale (1999) provides a 5-point scale, with 1 indicating no fatigue and 5 representing the worst fatigue possible (see Appendix A in the original guideline document).
      - 2. The revised Piper Fatigue Scale (PFS) includes four dimensions: mood/cognition, affective meaning, sensory, and behavioral/severity. This tool has 27 items

and is used for screening and outcome assessment (Piper et al., 1998).

3. The Brief Fatigue Inventory (BFI) has nine items and is useful for distinguishing severe fatigue but is less reliable for assessing mild to moderate fatigue (Mendoza et al., 1999).
4. The Functional Assessment of Cancer Therapy-Fatigue (FACT-F) has 13 items, identifies physical and psychological aspects of fatigue, and can be used for screening and outcome assessment (Cella, 1997, 1998).
5. The Multidimensional Fatigue Inventory (MFI-20) has 20 items and distinguishes general, physical, mental, reduced motivation and activity parameters, captures physical and psychological data, and can be used for screening and assessment of outcomes (Smets et al., 1995, 1996).
6. The Profile of Mood States (POMS) contains 65 items and measures tension-anxiety, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. This tool captures only psychological information and because of its length, it is too cumbersome for screening (McNair, Lorr, & Droppleman, 1992).

e. Follow-up assessment

1. Determine the effectiveness of fatigue management strategies. Although fatigue may resolve after treatment, some patients experience chronic fatigue, which can lead to psychological distress and depression and is negatively associated with quality of life (Jereczek-Fossa, Marsiglia, & Orecchia, 2002; Visser & Smets, 1998; Vordermark et al., 2002).
2. Provide self-assessment information; encourage discussion of concerns at follow up visits (Mock et al., 2003).

4. Management of treatable causes

a. Pharmacologic management

1. Anemia: At least five nonexperimental, open-label, community-based trials provide evidence that treating anemia reduces fatigue (Crawford et al., 2002; Demetri et al., 1998; Gabrilove et al., 1999; Glaspy et al., 1997; Quirt et al., 2001). The National Comprehensive Cancer Network (NCCN) guidelines panel on fatigue recommended that anemia be treated according to its cause (Mock et al., 2003).
  - a. Iron or folic acid deficiencies should be restored.
  - b. Blood loss can be replaced by transfusion.
  - c. Use recombinant human erythropoietin to treat anemia caused by chronic disease and/or treatment toxicity. Intervention is recommended before hemoglobin drops below 10 g/dl (Magnan & Mood, 2003).

2. Pain: The Agency for Healthcare Research and Quality (AHRQ) (2001) convened an expert panel that employed an explicit science-based methodology and expert clinical judgment to develop cancer pain management guidelines (Jacox, Carr, & Payne, 1994). The World Health Organization (WHO) ("Cancer pain relief," 1990) Analgesic Ladder is recommended for titrating therapy for cancer pain.
  - a. Use acetaminophen, aspirin, or a nonsteroidal anti-inflammatory drug (NSAID) for mild or moderate pain.
  - b. If pain persists or increases, add opioids, such as codeine, or hydrocodone.
  - c. If pain is persistent or moderate/severe at outset, increase opioid potency or use higher doses.
  - d. For persistent pain, administer medication around-the-clock, with additional doses as needed for breakthrough pain.
3. Depression: At least two systematic reviews support the pharmacologic treatment of depression (Berber, 1999; Guaiana, Barbui, & Hotopf, 2003). These reviews did not cite patients with cancer explicitly. Three well-known classes of drugs are used to treat depression (Barsevick & Much, 2004).
  - a. Selective serotonin reuptake inhibitors (SSRIs), including paroxetine, sertraline, and fluoxetine, slow the reabsorption of the neurotransmitter serotonin after release into the synapse.
  - b. Tricyclic antidepressants (TCAs), such as amitriptyline, doxepin, imipramine, and nortriptyline, increase the availability of the neurotransmitters norepinephrine and serotonin.
  - c. Monoamine oxidase inhibitors (MAOIs), such as phenelzine, tranylcypromine, and isocarboxazid, block the enzyme monoamine oxidase that normally breaks down norepinephrine and serotonin.
4. Sleep disturbance: Morin (1993) summarized the research on the pharmacologic treatment of insomnia (National Institutes of Health [NIH], 1984; "National Institutes of Health Consensus Development Conference Statement," 1991). Several classes of drugs are used to manage insomnia (Mills & Graci, 2004).
  - a. Nonbenzodiazepine hypnotics, including zaleplon and zolpidem, have a short half-life, so they induce sleep with few residual effects.
  - b. Benzodiazepines, such as triazolam, temazepam, and lorazepam, have a longer half-life and are associated with residual effects, including daytime fatigue and impairment of cognitive and psychomotor functioning.

- c. Antidepressants with sedative effects, such as trazodone, amitriptyline, and doxepin, may be used to treat insomnia.
- 5. Nutrition: Appetite stimulants, including megestrol acetate and dexamethasone, are effective in stimulating appetite and weight gain and improving well-being according to a systematic review (Brown, 2002).
- 6. Comorbidities: A clinically based recommendation of the National Comprehensive Cancer Network panel is to review comorbidities to determine if they are managed optimally. Stabilization may require the introduction of new medications, titration of current drugs, or both (Mock et al., 2003).
- b. Nonpharmacologic management
  - 1. Information: Numerous clinical trials have demonstrated that providing concrete objective information is effective in preparing individuals for a variety of healthcare experiences. Providing a description of physical sensations, causes, patterns, and consequences of a problem such as fatigue enables the individual and family to plan for it and maintain a sense of control over their experience (Diefenbach & Leventhal, 1996; Johnson et al., 1997; Reuille, 2002).
    - a. Physical sensations: Fatigue is the subjective feeling of being tired that persists and interferes with functioning. A person can feel mentally and/or physically fatigued. Fatigue may persist despite adequate rest or sleep (Barsevick, Whitmer, & Walker, 2001; Berger & Farr, 1999).
    - b. Potential causes of fatigue (see Section IV, B—Fatigue in the original guideline document)
    - c. Patterns
      - i. Fatigue pattern during radiotherapy (RT): Fatigue increases gradually over a five- to six-week course of therapy to a high point at the end of treatment, then gradually declines (Beck & Schwartz, 2000; Christman, Oakley, & Cronin, 2001).
      - ii. Fatigue pattern after completion of radiotherapy: It is estimated that up to 40% of individuals treated for cancer with radiotherapy could suffer from chronic fatigue; almost 20% have characterized their fatigue as severe (Jereczek-Fossa, Marsiglia, & Orecchia, 2002; Vordermark et al., 2002). The duration of fatigue after treatment is unknown.
    - d. Consequences of fatigue may include loss of capacity for physical performance (Mock, 2001) or decreased ability to function in usual activities (Barsevick, Whitmer, & Walker, 2001).  
Consequences of successful fatigue management

- include reduced fatigue and ability to maintain valued activities despite fatigue.
2. Energy conservation: One systematic review and two pilot studies demonstrated that energy conservation is effective in managing fatigue (Barsevick & Much, 2004; Barsevick et al., 2002; Tiesinga et al., 1999). Energy conservation is the planned management of energy resources to prevent or reduce fatigue.
    - a. Goal: To maintain valued activities through a balance of rest and activity
    - b. Strategies: Use of rest periods, priority setting, delegation of less important activities, pacing oneself, and performing demanding activities at times of peak energy
    - c. Techniques
      - i. Make a priority list of usual activities and delegate low priority activities to others.
      - ii. Keep a daily diary to learn fatigue patterns and use as a basis for scheduling valued activities.
  3. Attention restoration: One clinical trial has demonstrated that attention restoration reduced attentional fatigue in patients with cancer. Attention restoration is a self-care activity used to deal with mental fatigue, distraction, and difficulty concentrating (Cimprich, 1992, 1993).
    - a. Goal: To prevent or reduce mental fatigue
    - b. Characteristics of attention-restoring activities
      - i. Captures and holds one's attention.
      - ii. Provides a change from one's usual routine.
      - iii. Provides a sense of being removed from one's current environment.
    - c. Techniques
      - i. Select a restorative activity that is of personal interest (e.g., sitting, walking, observing a natural environment, tending plants, caring for a pet, reading, working on a craft project)
      - ii. Engage in the restorative activity for a minimum of 20 minutes per day at least three times per week.
      - iii. Keep a record of the time spent performing the restorative activity, as well as fatigue level before and after.
  4. Sleep education/hygiene: Interventions focused on cognitive, behavioral, and informational factors known to play a role in insomnia have been developed for healthy people with chronic insomnia. These techniques are used to modify maladaptive sleep habits, reduce arousal, and educate about healthy sleep practices (Hauri & Wisbey, 1994; Morin, 1993). However, these techniques have not been tested in patients with cancer (Savard & Morin, 2001). One pilot study of a sleep promotion plan for

patients with cancer has demonstrated the feasibility of this approach (Berger et al., 2002).

- a. Prevention of sleep problems through healthy sleep habits
    - i. Establish and maintain a regular bedtime/wake time.
    - ii. Stay in bed only for intended hours of sleep.
    - iii. Avoid eating, watching TV, or reading in bed.
    - iv. Avoid taking naps that could interfere with nighttime sleep.
    - v. Exercise regularly at least four hours prior to bedtime.
    - vi. Keep rooms fully illuminated during the day; reduce illumination at night.
  - b. Self-care interventions for sleep disturbance
    - i. Relaxation techniques
    - ii. Meditation
5. Cognitive behavioral therapies, especially relaxation techniques, have been widely tested during cancer treatment and demonstrated efficacy in reducing symptoms, including pain, nausea/vomiting, insomnia, and anxiety (Jacobsen & Hann, 1998). Several types of relaxation techniques can be used singly or in combination (Jacobsen & Hann, 1998; Mills & Graci, 2004).
- a. Progressive muscle relaxation: Flex and relax each body part several times in succession until all areas of the body are relaxed.
  - b. Guided imagery: Imagine a restful or peaceful scene with all the senses and use this scene to become relaxed.
  - c. Diaphragmatic breathing: Take slow, deep breaths while expanding the whole diaphragm and pushing out the stomach.
  - d. Body scan: Sit or lie in a comfortable position and pay attention to each body part for 20-30 seconds without judgment.
  - e. Meditation: Focus on a word, sound, or object while clearing all other thoughts from the mind.
6. Behavioral management of nutritional deficits: It is well known that cancer treatment can impair nutritional status resulting in fatigue. Behavioral interventions using relaxation techniques have demonstrated efficacy in improving physical well-being during cancer treatment (Fleishman, 1998; Jacobsen & Hann, 1998). However, there is no evidence that these approaches improve nutritional status. A variety of clinically based behavioral suggestions may be used (Cunningham, 2004).
- a. Eat small meals during the day.
  - b. Keep food and nutritional supplements close at hand.

- c. Avoid foods that have become unpalatable because of treatment.
- d. Unless there is a medical contraindication, "indulge" in previously avoided high-fat, high-cholesterol foods.
- e. Use social rituals, such as eating with others or drinking wine.

#### 7. Exercise

- a. A pilot study and a clinical trial of exercise for patients with breast cancer receiving radiotherapy has demonstrated fatigue reduction (Mock et al., 1997, 2001). Several other studies have documented efficacy during and/or after chemotherapy, biotherapy, and stem cell transplant (Dimeo, 2001; Dimeo et al., 1996, 1997; Dimeo, Rumberger, & Keul, 1998; Dimeo et al., 1999; Mock et al., 1997; Schwartz et al., 2001; Schwartz, Thompson, & Masood, 2002). A regular program of aerobic exercise (walking, bicycling, or self-selected exercise) has been found to be beneficial.
- b. Clinically based recommendations by National Comprehensive Cancer Network (Mock et al., 2003)
  - i. An exercise program should be individualized to the person's age, gender, and fitness level (Mock et al., 2000; Nail, 2002).
  - ii. Exercise recommendations should include type of exercise, intensity, duration, and frequency; guidance also should be provided about starting level and rate of progression to higher levels.
  - iii. Safety precautions
    - An individual with appropriate expertise should prescribe exercise.
    - For the individual with specific comorbidities (such as bone metastases) or in a deconditioned state, referral to a rehabilitation program or physical medicine may be appropriate.
    - The individual should be advised to avoid exercising one to two days after receiving chemotherapy and during periods of neutropenia, low platelets, anemia, or fever.
    - The individual should be told to discontinue exercise and seek medical attention if he or she has shortness of breath, chest pain,

dizziness, nausea/vomiting, or pain during activity.

5. Documentation (Refer to the original guideline document for details)
6. Patient and family education outcomes (Refer to the original guideline document for details)
7. Teaching tools (Refer to the original guideline document for details)

C. Skin reactions

1. Pathophysiology (Refer to the original guideline document for details)
2. Incidence (Refer to the original guideline document for details)
3. Staging/assessment of symptoms
  - a. Radiation-induced skin reactions are dependent on time-dose factors rather than on the total dose delivered (Archambeau, 1987).
  - b. Radiation-induced skin reactions range from erythema, where different shapes of redness occur from the release of histamine-like substances from damaged germinal cells, to dry desquamation (dry, flaky, or scaly skin) because the sweat and sebaceous glands have been damaged, or to moist desquamation where blistering, peeling, and sloughing of the skin occur. Damage to the hair follicles and sweat glands can be permanent. Rarely seen is necrosis, which involves damage to the deeper layers of the skin.
  - c. National Cancer Institute (NCI) (2003) has a four-point scale of color stages or skin patterns; however, the patient's feeling is missing in this scale. Further assessment could include subjective pain (0-10 scale), sensation feeling (burning, prickly, or pruritus), and interference with activities of daily living.
  - d. Assessment should include treatment fields and exit sites.

4. Acute effects

- a. The major acute side effects to the skin while receiving RT are erythema, dry desquamation, moist desquamation, and ulceration. The overall goal is to keep the skin intact by minimizing scratching and rubbing and keeping the skin moisturized. If moist desquamation develops, the goal is to support epithelial recovery and avoid superinfections.
- b. Interventions
  1. During treatment planning, special positioning devices may be used to reduce skin folds.
  2. All surgical wounds should be healed before initiating RT.
  3. Very few randomized studies have been conducted to evaluate skin care products; most are anecdotal. No standardized protocols are available on skin care products (Moore-Higgs & Amdur, 2001; Pazdur et al., 2003). Although not an exhaustive list, available products for erythema include
    - a. Aquaphor® (Beiersdorf, Hamburg, Germany)\*
    - b. Eucerin® (Biersdorf)\*

- c. TheraCare™ (Emumagic, Nevis, MN\* (pure lanolin cream)
    - d. Vitamin A & E ointment/cream\*
    - e. Biafine® (Medix Pharmaceuticals Americas, Largo, FL) (RTOG 97-13 demonstrated no prophylactic capability [Fisher et al., 2000].)
    - f. Aloe vera gels\* (No skin differences were seen with aloe vera gels [Williams, Burk, & Loprinzi, 1996].)
    - g. Natural skin care gel\*
    - h. Chamomile and almond oil (Skin changes appeared later [Maiche, Grohn, & Maki-Hokkonen, 1991].) (\* Indicates no studies found on product)
  - 4. For moist desquamation
    - a. Normal saline compresses or modified Burow's solution soaks for 15-20 minutes, three times a day (Pazdur et al., 2003)
    - b. Use moisture vapor permeable dressings (e.g., Tegaderm™ [3M, Maplewood, MN], OpSite® [Smith & Nephew, Largo, FL], Bioclusive™ [Johnson & Johnson, San Francisco, CA]) or hydrocolloid dressings. Do not use dry dressings.
    - c. Vaseline petrolatum gauze provides a moisture barrier, easy to take off prior to treatment.
  - 5. Historically, use of topical agents (e.g., lotions, deodorants) prior to RT is discouraged. Recent studies indicate only a small amount (1%-5%) of skin dose increased when products were used prior to treatment. The only contraindications were the chemical irritants in the products (Burch et al., 1997).
  - 6. Use of cornstarch is debatable. Instructions vary from not recommending its use, especially with moist desquamation (because of potential for fungal infections), to recommending its use instead of baby powder.
5. Long-term effects
- a. Major late side effects: Telangiectasias, fibrosis, and/or necrosis can occur after receiving therapy. The goal is to improve skin texture and elasticity.
  - b. Interventions
    - 1. Keep the skin moist and supple with moisturizing lotions.
    - 2. Use sunblocks.
6. Documentation (Refer to the original guideline document for details)
7. Patient and family education outcomes (Refer to the original guideline document for details)

#### D. Pain

- 1. Pathophysiology (Refer to the original guideline document for details)

2. Incidence (Refer to the original guideline document for details)
3. Assessment is the cornerstone of effective pain management. All patients with cancer should be screened for pain at each encounter with the healthcare system. If the patient reports pain during the universal screening procedure, a comprehensive pain assessment should be conducted to evaluate for persistent and breakthrough pain and to diagnose the cause of the pain. Ongoing assessments should be performed to determine the effectiveness of the pain management plan.
  - a. Comprehensive pain assessment--Determines the cause of the patient's pain
    1. Persistent pain--Constant pain that lasts for long periods of time
      - a. Onset
      - b. Description
      - c. Location
      - d. Intensity/severity (rated using a 0 [no pain] to 10 [worst pain imaginable] numeric rating scale)
      - e. Aggravating and relieving factors
      - f. Previous and current treatments and their effectiveness
      - g. Associated symptoms--Fatigue, insomnia, depression, changes in appetite (Miaskowski et al., 2004)
    2. Breakthrough pain--Sudden severe flare-ups of pain that come and go (Hwang, Chang, & Kasimis, 2003; Mercadente et al., 2002)
      - a. Presence of breakthrough pain
      - b. Frequency and duration of the episodes of breakthrough pain
      - c. Intensity
      - d. Occurrence of the painful episode--Spontaneous, incident
      - e. Previous and current treatments and their effectiveness
  3. Physical examination
    - a. General examination
    - b. Focused neurologic examination
  4. Appropriate diagnostic tests--Pain medication should be administered to facilitate the diagnostic workup.
- b. Ongoing pain assessments--Should determine if the pain management plan is effective.
  1. Evaluation of pain intensity
  2. Evaluation of pain relief
  3. Evaluation of the impact of pain on functional status and quality of life
  4. Evaluation of patient's level of adherence with the pain management plan

4. Documentation
  - a. Document the results of universal screening for pain at each patient visit.
  - b. Document the findings from the comprehensive pain assessment in the patient's medical record.
  - c. Document ratings of pain intensity at each visit.
5. Collaborative management
  - a. Use appropriate combinations of nonopioid, opioid, and co-analgesics, depending on the cause and the severity of the patient's pain (Miaskowski et al., 2004).
    1. Nonopioid analgesics (e.g., acetaminophen, NSAIDs)
      - a. Indicated for mild to moderate pain
      - b. Have a narrow therapeutic window and a ceiling effect
    2. Opioid analgesics
      - a. Indicated for moderate to severe pain
      - b. Doses and schedules should be adjusted to produce maximal analgesia with minimal side effects.
    3. Co-analgesics are medications that do not have a primary indication for pain but produce analgesia. These medications often are used in the management of neuropathic pain.
  - b. Chronic persistent pain should be managed with a long-acting opioid that is administered on a regular schedule. Breakthrough pain should be managed with a short-acting opioid that is administered on an as-needed basis.
  - c. Side effects of nonopioid, opioid, and coanalgesics should be monitored and managed to improve adherence with the pain management plan.
  - d. Nonpharmacologic strategies should be used to supplement pharmacologic strategies in the management of cancer pain.
    1. Relaxation
    2. Distraction
    3. Guided imagery
  - e. Pain from bone metastasis may be treated with RT or radiopharmaceuticals (e.g., strontium-89, samarium-153). Analgesic regimens may require adjustment following the administration of these therapies.
6. Patient and family education (Refer to the original guideline document for details)

E. Distress/coping

1. Pathophysiology (Refer to the original guideline document for details)
2. Incidence (Refer to the original guideline document for details)
3. Assessment
  - a. Risk factors associated with distress and problems coping with cancer
    1. Cancer site--More depression has been documented among patients with specific tumor types.

- a. Patients with head and neck cancers have reported high levels of depression usually linked to lifestyle behaviors and lack of social support (de Leeuw et al., 2000).
  - i. A recent study showed that although other measures of quality of life improved over time for patients treated with radiotherapy for head and neck cancers, emotional functioning and depression did not improve by one month post-treatment (Rose & Yates, 2001).
  - ii. However, other studies have shown improvement in depressive symptoms of head and neck patients at 12 months post-radiotherapy (de Graeff et al., "A prospective study on quality of life of laryngeal cancer patients," "A prospective study on quality of life of patients with cancer of the oral cavity," 1999; de Leeuw et al., 2000).
- b. Patients with breast cancer also have high levels of documented anxiety and depression.
  - i. One study documented that 14% of women referred for adjuvant radiotherapy following surgery had morbid anxiety (Maraste et al., 1992).
    - Significant depression was recorded for only 1.5% of patients, but severe anxiety was recorded in 19% of patients with mastectomies versus 10% of those treated with breast-conserving surgery
    - In a subgroup aged 50-59 years, morbid anxiety was significantly more common among patients with mastectomies (44%) than among patients treated with breast-conserving surgery and radiotherapy (4%)
    - The results suggest that at the start of adjuvant radiotherapy, emotional distress is characterized by anxiety rather than depression, and the risk of serious anxiety is especially high for women with mastectomies in their 50s.
  - ii. In a study of women with early-stage breast cancer who were referred for adjuvant radiotherapy (Mose et al., 2001)
    - 53% of the women felt distressed because cancer affected the breast.

- 48% were initially afraid of radiotherapy.
    - 36% never had their anxiety reduced during treatment.
  - iii. Predictors of high levels of distress in women with breast cancer include (Mose et al., 2001)
    - Age 58 years or younger
    - Initial anxiety
    - Being negatively affected by environmental factors
    - Those who did not find distraction helpful
2. Age: Younger age has been associated with higher levels of anxiety/depression (Compas et al., 1999; Epping-Jordan et al., 1999).
  3. Poor pretreatment coping ability has been associated with post-treatment maladaptive coping (Dropkin, 1997; Holland, 1997).
  4. History of psychiatric problems is associated with an increased risk of poor coping (Leopold et al., 1998).
  5. High levels of social support have been shown to be associated with better coping; conversely, low levels of social support are associated with poorer coping with cancer (Akechi et al., 1998; Penninx et al., 1998; Sollner et al., 1999).
- b. Assessment measures: Few reports in the literature exist of the testing of clinically relevant and easy-to-use assessment tools for anxiety and depression in the outpatient radiation oncology setting.
1. One RT-specific study (Leopold et al., 1998) found a short, structured interview procedure, Primary Care Evaluation of Mental Disorders (PRIME-MD) that allowed radiation oncologists to quickly and reliably identify mood disorders in their patients.
    - a. A diagnosis of a depressive or anxiety disorder by PRIME-MD was made in 59 of the 122 patients (48%) (Leopold et al., 1998).
    - b. PRIME-MD has had extensive testing in other patient settings (Spitzer, Kroenke, & Williams, 1999).
  2. Many tools for the assessment of anxiety and depression are available, and more comprehensive reviews can be found elsewhere (Barsevick & Much, 2004; Bruner & Diefenbach, 2001; Gobel, 2004).
    - a. Spielberger State-Trait Anxiety Inventory
    - b. Hospital Anxiety and Depression Scale
    - c. Center for Epidemiological Studies Depression Scale
    - d. Impact of Event Scale

- e. Medical Outcomes Study-Depression Scale
- 3. Documentation should include
  - a. Risk factors for distress described previously
  - b. For those at risk, screening and/or diagnosis of anxiety/depression should be documented with one of the assessment tools described.
  - c. Because most radiotherapy departments do not conduct such screening or diagnostic assessments, documentation of referral to appropriate medical personnel (social worker, psychologist, psychiatrist, mental health nurse practitioner) is essential.
  - d. The ONS Radiation Therapy Patient Care Record (Catlin-Huth, Haas, & Pollock, 2002): Emotional alterations--Coping
    - i. 0--Effective
    - ii. 1--Ineffective
- 4. Acute and late effects and evidence-based management
  - a. Major barriers exist to implementation of effective strategies to improve coping because of
    - 1. Lack of knowledge of the multifaceted nature of cancer distress
    - 2. Outmoded attitudes of patients, staff, and institutions about psychological issues
    - 3. Stigmatizing labels for those who access psychological therapy (Bruner & Diefenbach, 2001)
  - b. Guidelines for the treatment of distress related to cancer have been developed for evaluation, treatment, and follow-up of the general patient with cancer, as well as specific information for the management of patients with
    - 1. Adjustment disorders
    - 2. Major depressive disorder
    - 3. Delirium
    - 4. Anxiety
    - 5. Dementia
    - 6. Substance abuse disorder
    - 7. Personality disorders ("NCCN practice guidelines," 1999)
  - c. Although depression is rarely if ever helpful, certain levels of anxiety followed by problem-focused coping strategies have been associated with more effective post-treatment coping in patients treated with and without RT (Dropkin, 1997).
  - d. The nursing challenge with such a complex, multifaceted problem as distress is finding strategies that are realistic within the primarily outpatient radiotherapy department. Something as simple as a brief orientation program has been shown to reduce anxiety, depressive symptoms, and overall distress in outpatients with cancer.
    - 1. One study (McQuellon et al., 1998) assigned 150 patients to an intervention (a clinic tour, general information about clinic operations, and a question and answer session with an oncology counselor) or usual care control group.

2. The intervention group had lower state anxiety, lower overall distress, and fewer patients reporting depressive symptoms (McQuellon et al., 1998).
- e. Behavioral management
1. Relaxation training and guided imagery have shown positive results in patients with anxiety and, in some cases, depression.
    - a. The feeling of anxiety is associated with muscle tension and increased heart rate (the fight or flight response) and is theorized to be unable to exist in the process of progressive muscle relaxation (Jacobson, 1964; McGuigan, 1993).
    - b. In a study of 82 outpatients who were undergoing curative (73 patients) or palliative (9 patients) radiotherapy assigned to either relaxation training or a control condition that included education and counseling along with the RT, significant reductions were noted in the treatment group in tension, depression, anger, and fatigue (Decker, Cline-Elsen, & Gallagher, 1992).
  2. Music therapy
    - a. Music therapy has been shown to decrease anxiety in patients receiving chemotherapy.
    - b. The only reported music therapy study specifically tested in patients receiving RT showed no significant difference in anxiety levels between the group assigned to music therapy during radiotherapy and the control group. However, further analyses identified changes and trends in state anxiety scores, suggesting a possible benefit of music therapy during radiotherapy, thus requiring more research (Smith et al., 2001).
  3. Success of distraction techniques, including imagery or music therapy, is highly individual and related to the patient's past use and perceived credibility. Patients' preference for their use should be assessed and not assumed (Kwekkeboom, 2001, 2003).
  4. Group therapy may decrease distress and improve coping for patients with cancer undergoing radiotherapy.
    - a. In a study of 48 patients receiving radiotherapy, subjects assigned to the psychotherapy group (six patients per group, 90-minute weekly sessions for 10 weeks) showed significant decreases in both emotional and physical symptoms, and the decreases were greater at four weeks after the end of radiotherapy compared to the control group (Forester et al., 1993).
    - b. In one study (Evans & Connis, 1995), 72 patients with cancer who were diagnosed with depression were randomly assigned to one of three

conditions: cognitive-behavioral treatment, social support, and a no-treatment control condition. Both the cognitive-behavioral and social support therapies resulted in less depression, hostility, and symptoms versus the control group. The social support intervention also resulted in fewer psychiatric symptoms and reduced maladaptive interpersonal sensitivity and anxiety. The social support groups demonstrated more changes that were evident at the six-month follow-up.

5. Cognitive therapy

- a. Interest in biofeedback waxes and wanes, and no positive studies in the literature are RT- or cancer outpatient-specific. Much of cognitive therapy currently centers on distraction.
- b. A recent study showed that a virtual reality distraction intervention for women aged 50 and older decreased anxiety levels immediately following chemotherapy treatments. There was a trend toward improved symptoms at 48 hours following completion of chemotherapy. For this study, a head-mounted display (Sony PC Glasstron PLM-S700®) was used to display encompassing images and block competing stimuli during chemotherapy infusions (Schneider et al., 2003).

6. Medical management

- a. Psychotherapy and pharmacotherapy combined are more effective than either alone in treating emotional distress, as well as in preventing the relapse of distress in patients with cancer (Twillman & Manetto, 1998). Patients should receive appropriate referrals.
- b. Pharmacotherapy alone (For more comprehensive lists, drug interactions, and evidence-based management, see Barsevick & Much, 2004; Bruner & Diefenbach, 2001; Gobel, 2004.)
  - i. Benzodiazepines (e.g., diazepam, alprazolam)—Most commonly used for acute and chronic anxiety
  - ii. Selective serotonin reuptake inhibitors (e.g., paroxetine, fluoxetine)--Most commonly used for depression caused by cancer
    - Demonstrated efficacy in treating cancer-related depressive symptoms, at least in women with cancer (Holland et al., 1998; Pezzella, Moslinger-Gehmayr, & Contu, 2001)
    - May be better suited for use in depressed patients with cancer

because they lack the significant adverse anticholinergic and cardiovascular effects of tricyclic antidepressants

- iii. Tricyclic antidepressants (e.g., amitriptyline, doxepin)
- iv. Lithium
- v. Monoamine oxidase inhibitors (e.g., phenelzine, tranylcypromine)
- c. Herbal therapies (e.g., ginseng, St. John's wort)—more commonly used for anxiety than depression; little evidence of effectiveness exists. (For a more comprehensive list, see Gobel, 2004.) Patients always should discuss use with their physician, because some herbal therapies may interfere with prescribed medications.

- 5. Patient and family education and outcomes (Refer to the original guideline document for details)

#### F. Sexual dysfunction

- 1. Pathophysiology (Refer to the original guideline document for details)
- 2. Incidence (Refer to the original guideline document for details)
- 3. Assessment
  - a. Risk factors: Sexual activity pretreatment appears to be the best predictor of sexual function post-treatment (Andersen, Cyranowski, & Espindle, 1999). Pretreatment dysfunction needs to be assessed because it leads to a greater risk of sexual problems post-RT.
  - b. Sexual history
    - 1. Age: Especially important in assessing sexual function because changes occur frequently with age as a result of comorbidities (Burns-Cox & Gingell, 1997).
    - 2. Cultural/ethnic background: Sexual values and norms vary widely among cultures (Meston, Trapnell, & Gorzalka, 1996; Wyatt et al., 1998).
    - 3. History of sexual activity, including sexual orientation, age at first intercourse, number of partners, marital discord, and problems with desire, arousal, or orgasm
    - 4. History of sexual abuse: An estimated 300,000 women are raped each year (U.S. Department of Justice, 2002); it has been estimated that 16% of women treated for gynecologic malignancies have been sexually abused (Bergmark et al., 1999).
    - 5. Frequency of sexual activity over past six months
    - 6. Satisfaction with sexual ability and frequency
    - 7. Medications that may interfere with sexual function (e.g., antihypertensives, antidepressants)
    - 8. Female issues
      - a. Dyspareunia
      - b. Vaginal dryness

9. Male issues
  - a. Erectile ability
  - b. Retrograde ejaculation
- c. Physical examination
  1. Female
    - a. Check skin over vulva and around anus for breakdown, lesions, or inflammation.
    - b. Check for vaginal stenosis.
    - c. Check for vaginal discharge or bleeding.
  2. Male
    - a. Check skin over the penis and scrotum for breakdown, lesions, or inflammation.
    - b. Check anal area for breakdown, fissures, or lesions.
- d. Documentation (in addition to above) (Catlin-Huth, Haas, & Pollock, 2002)
  1. Sexual alteration
    - a. 0--Absent
    - b. 1--Present
  2. Vaginal drainage
    - a. 0--Absent
    - b. 1--Present
4. Acute effects and evidence-based management
  - a. Psychological--Prepare the patient for the possible effects of treatment on sexual function.
  - b. Behavioral
    1. Discuss need for patient to manage symptoms (e.g., pain) before trying to engage in sexual activity.
    2. Encourage communication between the patient and partner concerning fears regarding continued sexual function.
  - c. Medical
    1. A recent structured review of the literature found the strongest evidence of treatment benefit for acute radiation vaginal changes to be topical estrogens and benzydamine (Denton & Maher, 2003).
    2. The structured literature review also found evidence to support the use of vaginal dilators to maintain vaginal patency (Denton & Maher, 2003)
    3. Use of dilators should begin as soon as patient can tolerate it to prevent adhesions from forming.
      - a. Patient can begin during radiotherapy if she can tolerate it.
      - b. A condom stuffed with cotton balls and tied at the bottom, used with ample lubricant, may make the experience more tolerable.
5. Long-term effects and evidence-based management
  - a. Psychological

1. Support the patient with concerns regarding sexual function.
2. Refer patients with history of sexual abuse or marital problems to a social worker, family therapist, or sex counselor.
- b. Behavioral
  1. Encourage communication between the patient and partner concerning fears regarding continued sexual function.
  2. Teach proper positioning for continued sexual activity that would prevent discomfort depending on the therapy or problem (Bruner & Berk, 2004).
- c. Medical
  1. Women need to continue to have something (penis or vaginal dilator) dilate the vagina at least three times per week for life.
  2. Vaginal dryness can be managed with water-soluble lubricants (Bruner & Berk, 2004).
  3. Medications such as sildenafil have been shown to improve erectile function post-RT for prostate cancer (Kedia et al., 1999; Merrick et al., 1999; Valicenti et al., 2001; Weber et al., 1999; Zelefsky et al., 1999).
  4. Refer men to a urologist. For men who are not candidates for oral medications to improve erections, other potential treatments include penile implants, injectable medications, or vacuum devices. Positive outcomes have been reported with some erectile aids (Litwin et al., 1999).
  5. Refer women to a urologist or sex therapist.
  6. Sildenafil may improve both subjective and physiologic parameters of the female sexual response (Berman et al., 2001), although this has not been tested in women with sexual dysfunction related to cancer therapies.
  7. Fertility issues after RT are beyond the scope of this outline, and readers are referred elsewhere (Bruner, 2001).

6. Patient and family education (Refer to the original guideline document for details)

#### G. Nutrition

1. Pathophysiology (Refer to the original guideline document for details)
2. Incidence (Refer to the original guideline document for details)
3. Assessment
  - a. Risk factors
    1. Poor or inadequate dietary intake prior to treatment (Polisena, 2000)
    2. Weight loss >5% in one month, >10% in six months (Polisena, 2000)
    3. Alcohol and tobacco use (Polisena, 2000)
    4. Vitamin and mineral supplementation--No recommended minimum or maximum level of antioxidants exists during

radiation treatment for patients with cancer. However, megadoses are discouraged, as they may decrease the effectiveness of cancer therapy (Mayer & Ferguson, 2002).

5. Herbal supplement use may delay cancer treatment or interact with certain types of cancer treatment (Montbriand, 1999; Spaulding-Albright, 1997)
  6. Medical history--Concurrent illnesses/diseases (diabetes, coronary artery disease [CAD], dementia, depression) (Polisena, 2000)
  7. Social situations--Poverty, diminished self-care ability or lack of caretaker (Polisena, 2000)
  8. Concurrent therapies (e.g., aggressive chemotherapy) (Polisena, 2000)
- b. Clinical manifestations of RT affecting nutrition (Darbinian & Coulston, 1990; Dow et al., 1997)
1. Central nervous system (CNS): Headaches, seizures, altered mental status, nausea, vomiting
  2. Head and neck areas: Dry mouth, taste changes, weight loss, dysphagia, pain, decrease in the width of mouth opening, sore throat, changes in saliva production, chewing problems
  3. Thorax areas: Dysphagia, indigestion, early satiety, weight loss, pain, shortness of breath
  4. Abdomen and pelvis: Nausea, vomiting, diarrhea, bloating, flatulence, constipation
- c. Physical examination (Decker et al., Dow et al., 1997)
1. Baseline data
    - a. Physical exam (e.g., height/weight, body mass index [BMI])
    - b. Basal energy expenditure (BEE), vital signs
    - c. Estimating energy needs
    - d. Estimating protein needs
    - e. Laboratory data (e.g., albumin, hemoglobin, transferrin, hematocrit, white blood cell count, electrolytes, liver function tests)
    - f. Patient-Generated Subjective Global Assessment (PG-SGA)--Ottery (2001) modified it for use in an oncology population (see Appendix B in the original guideline document).
      - i. 0--Minimal impact on nutritional status (stage A)
      - ii. 1--Mild impact
      - iii. 2--Moderate impact (stage B)
      - iv. 3--Potentially severe impact
      - v. 4--Potentially life threatening (stage C)
    - g. Interpretation of total scores--Ottery (2001) recommended
      - i. 0-1--No intervention; reassess on a regular basis

- ii. 2-3--Patient/family teaching by nurse, dietitian, or other clinician; pharmacologic intervention as needed; laboratory assessment may be warranted
    - iii. 4-8--Dietitian intervention necessary, together with nurse or physician to manage nutritional impact symptoms
    - iv. ≥9--Critical need for improved symptom management and/or nutritional intervention
  - 2. Examination: Assessment
    - a. General appearance
    - b. Karnofsky Performance Status (see [www2.mc.duke.edu/depts/hospital/9200bmt/Karnofsky.htm](http://www2.mc.duke.edu/depts/hospital/9200bmt/Karnofsky.htm))
    - c. Oral cavity: Infections, dental condition
    - d. Nutritional intake: Fluids, calories, and proteins
    - e. Skin turgor
    - f. Edema
    - g. "Quick Guide to Estimating Energy Needs in Adults" (Dempsey & Mullen, 1985)
    - h. "Quick Guide to Estimating Protein Needs in Adults" (Dempsey & Mullen, 1985)
    - i. Scored Patient-Generated Subjective Global Assessment (see Appendix B in the original guideline document)
  - 3. Knowledge of alternative mode of feeding (tube feeding), if indicated
- 4. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - a. Weight loss (NCI, 2003)
    - 1. Grade 1-5% to <10% from baseline
    - 2. Grade 2-10% to <20% from baseline
    - 3. Grade 3->20% from baseline
  - b. Anorexia (NCI, 2003)
    - 1. 1--Loss of appetite without alteration in eating habits
    - 2. 2--Oral intake altered without significant weight loss or malnutrition; oral nutrition supplements indicated
    - 3. 3--Associated with significant weight loss or malnutrition (e.g., inadequate oral caloric and/or fluid intake); IV fluids, tube feedings, or TPN indicated
    - 4. 4--Life-threatening consequences
    - 5. 5--Death
  - c. Nausea (NCI, 2003)
    - 1. 1--Loss of appetite without alteration in eating habits
    - 2. 2--Oral intake decreased without significant weight loss, dehydration, or malnutrition; intravenous (IV) fluids indicated <24 hours.
    - 3. 3--Inadequate oral caloric or fluid intake; IV fluids, tube feedings, or total parenteral nutrition (TPN) indicated ≥24 hours.
    - 4. Life-threatening consequences
    - 5. 5--Death

- d. Vomiting (NCI, 2003)
  - 1. 1--One episode in 24 hours
  - 2. 2--Five episodes in 24 hours
  - 3. 3--More than six episodes in 24 hours; need for IV fluids
  - 4. 4--Requiring parenteral nutrition; physiologic consequences requiring intensive care; hemodynamic collapse; life-threatening consequences
  - 5. 5--Death
- e. Diarrhea (NCI, 2003)
  - 1. 1--Increase of less than four stools/day over baseline
  - 2. 2--Increase of four to six stools/day
  - 3. 3--Increase of more than seven stools/day or incontinence; need for parenteral support for dehydration
  - 4. 4--Physiologic consequences requiring intensive care; hemodynamic collapse
  - 5. 5--Death
- f. Salivary gland changes (NCI, 2003)
  - 1. 1--Slightly thickened saliva; may have slightly altered taste (e.g., metallic); additional fluids may be required
  - 2. 2--Thick, ropy, sticky saliva; markedly altered taste; alteration in diet required
  - 3. 3--Symptoms leading to inability to adequately aliment orally; IV fluids, tube feedings, or TPN indicated
- g. Taste disturbance (NCI, 2003)
  - 1. 1--Slightly altered; no change in diet
  - 2. 2--Markedly altered with change in diet; noxious or unpleasant taste; loss of taste
- h. Constipation (NCI, 2003)
  - 1. 1--Requiring stool softener or dietary modification
  - 2. 2--Requiring laxatives
  - 3. 3--Obstipation requiring manual evacuation or enema
  - 4. 4--Obstruction or toxic megacolon
  - 5. 5--Death
- i. Dyspepsia and/or heartburn (NCI, 2003)
  - 1. 1--Mild
  - 2. 2--Moderate
  - 3. 3--Severe

## 5. Collaborative management

- a. Early nutritional intervention is key. Preventing cancer-induced weight loss and other symptoms helps to promote better tolerance to treatment and a better quality of life.
- b. Instruct the patient on consuming a high-calorie/high-protein diet and commercial nutrition supplements to maintain proper nutritional intake (Ross, 1990).
- c. Instruct the patient about the importance of exercise to enhance tolerance of cancer treatments and to stimulate appetite.
- d. Instruct the patient and caregiver on bland, moist, soft, nonacidic, low-lactose, and low-residue foods.
- e. Consult with clinical dietitian or speech pathologist for patients at risk for aspiration.

- f. Encourage the use of enteral nutrition. Enteral nutrition, also referred to as tube feeding, is indicated for patients who are unable to ingest adequate calories, protein, vitamins, minerals, and fluid by mouth yet have a functional gastrointestinal (GI) tract. Indications for enteral nutrition support include states of hypermetabolism, as in sepsis, burns, or trauma, neurologic disease, such as stroke or dysphagia, GI disease, oncologic disease, psychiatric disease, and organ system failure. Contraindications for enteral nutrition are a malfunctioning GI tract, mechanical obstruction or ileus, severe GI hemorrhage, intractable vomiting or diarrhea, and high-output GI tract (Mercadante, 1998). Think of parenteral nutrition as the last resort to maintain gut mobility. If TPN is truly indicated, observe for refeeding syndrome. Refeeding syndrome is characterized by fluid retention leading to cardiac decompensation and rapid drop in serum levels of phosphorus, magnesium, and potassium (Hearing, 2004).
- g. Counseling early in a patient's course of treatment is necessary. The importance of maintaining good nutrition, curtailing further weight loss, and discussing the anticipated eating difficulties all should be reviewed with the patient and family.
- h. Encourage oral health examination (see section V, B—Head and Neck in the original guideline document).
- i. Encourage the importance of eating small, frequent meals.
- j. Monitor hydration closely and replace electrolytes as needed.
- k. Suggest bulking agents and pectin to control diarrhea in patients receiving radiation to the pelvis (Walker & Masino, 1998).
- l. Anticipate the need to start appetite stimulants early. Pharmacologic management can include
  1. Megestrol acetate--Progestational agent, stimulates appetite and weight gain but mostly as fat; dose dependent; hypogonadism (impotence, muscle loss); decreases glucose tolerance and GI tolerance (nausea/vomiting/diarrhea, gas, dry mouth) (Bruera, 1998)
  2. Dronabinol--Appetite maintained long-term (improves mood, decreased nausea, increased weight); no adverse GI side effects; no development of tolerance to therapeutic effects/no toxicity; no addiction, side effects (seem to be age-related; decreasing dose may eliminate/lessen adverse effects, 2.5 mgs bid) (Von Roenn, 2002)
  3. Corticosteroids (dexamethasone)--Short-lived appetite, no real weight gain; muscle loss/weakness, osteoporosis, fluid retention, high blood sugar, electrolyte disturbances, insomnia, gastric irritation (nausea/vomiting) (Von Roenn, 2002)
  4. Cyproheptadine--Antiserotonergic, antihistamine approved in the United States for treatment of allergic disorders. Studies have been conducted with patients with cancer, acquired immunodeficiency syndrome (AIDS), dry mouth, and drowsiness and urination

difficulties; limited efficacy (most patients stop before three months because of clinical deterioration) (Bruera, 1998).

5. Hydrazine sulfate--Evaluated because of ability to inhibit gluconeogenesis; in vitro data suggest it inhibits tumor necrosis factor cytolytic activity; well tolerated, no toxicity but no appetite gains or weight gains (Bruera, 1998)
6. Anabolic agents--Testosterone derivatives; well studied in patients with acquired immunodeficiency syndrome but not those with cancer; cannot be used in some cancers; need for more studies (Bruera, 1998)
7. Metoclopramide--Treats early satiety; delayed gastric emptying may occur in up to 60% of patients with cancer; patients with dysmotility will benefit the most, usually at 10 mg four times per day (qid); side effects respond to dose reduction (diarrhea and hyperactivity); use in combination with narcotic analgesic (Bruera, 1998).

6. Patient/family education (Refer to the original guideline document for details)

## Site-specific Management

### A. Brain and central nervous system

1. Categories (Refer to the original guideline document for details)
2. Incidence and epidemiology (Refer to the original guideline document for details)
3. Molecular genetics (Refer to the original guideline document for details)
4. Routinely irradiated tumors (Karim, 1995)
  - a. Anaplastic gliomas, grades 3 and 4
  - b. Medulloblastomas, ependymomas, malignant pineal tumors
  - c. Primary malignant lymphomas, malignant meningiomas, primitive neuroectodermal tumors
  - d. Cerebral metastases
  - e. Pituitary nonhormone active adenomas
  - f. Pituitary hormone active tumors resistant to surgical and medical intervention
  - g. Tumors with threatening symptomatology
  - h. Craniopharyngioma
  - i. Deep seated, inoperable tumors
5. Symptoms of cranial irradiation
  - a. Cerebral edema
    1. Pathophysiology (Refer to the original guideline document for details)
    2. Incidence (Refer to the original guideline document for details)
    3. Assessment
      - a. Clinical manifestations (Bucholtz, 1997)

- i. Generalized edema
      - Headache
      - Nausea and vomiting
      - Changes in mentation
    - ii. Focal signs
      - Weakness of extremities
      - Visual changes
      - Seizures
      - Speech problems
      - Cranial neuropathy
  - b. Physical and neurologic exam
- 4. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - a. Karnofsky Performance Scale: 0-100
  - b. Pain location--Identify location
  - c. Pain intensity--0-10
  - d. Pain intervention
    - i. 0--None
    - ii. 1--Over-the-counter medication
    - iii. 2--NSAIDs or nonopioids
    - iv. 3--Opioids
    - v. 4--Adjuvant medication
    - vi. 5--Complementary methods
  - e. Effectiveness of pain intervention
    - i. 0--No relief
    - ii. 1--Pain relieved 25%
    - iii. 2--Pain relieved 50%
    - iv. 3--Pain relieved 75%
    - v. 4--Pain relieved 100%
  - f. CNS alteration: Depressed level of consciousness
    - i. 0--Normal
    - ii. 1--Somnolence or sedation not interfering with function
    - iii. 2--Somnolence or sedation interfering with function but not interfering with activities of daily living
    - iv. 3--Obtundation or stupor; difficult to arouse; interfering with activities of daily living
    - v. 4--Coma
  - g. Orientation to person, place, and time
  - h. Neuropathy--Motor
    - i. 0--Normal
    - ii. 1--Subjective weakness but no objective findings
    - iii. 2--Mild objective weakness interfering with function but not interfering with activities of daily living
    - iv. 3--Objective weakness interfering with daily living
    - v. 4--Paralysis
  - i. Ataxia
    - i. 0--Absent
    - ii. 1--Present

- j. Speech impairment
  - i. 0--Normal
  - ii. 1--
  - iii. 2--Awareness of receptive or expression aphasia, does not impair ability to communicate
  - iv. 3--Receptive or expressive dysphasia, impairs ability to communicate
  - v. 4--Inability to communicate
- k. Seizures
  - 1. 0--None
  - 2. 1--
  - 3. 2--Seizure(s) self-limited and consciousness is preserved
  - 4. 3--Seizures(s) in which consciousness is altered
  - 5. 4--Seizures of any type that are prolonged, repetitive, or difficult to control (e.g., status epilepticus, intractable epilepsy)
- l. Sensory alteration: Ocular/visual
  - i. 0--Normal
  - ii. 1--Mild
  - iii. 2--Moderate
  - iv. 3--Severe
  - v. 4--Unilateral or bilateral loss of vision (blindness)
- m. Nausea
  - i. 0--None
  - ii. 1--Able to eat
  - iii. 2--Oral intake significantly decreased
  - iv. 3--No significant intake
- n. Vomiting
  - i. 0--None
  - ii. 1--One episode in 24 hours over pretreatment
  - iii. 2--Two to five episodes in 24 hours over pretreatment
  - iv. 3--More than six episodes in 24 hours over pretreatment or need for IV fluids
  - v. 4--Requiring parenteral nutrition, physiologic consequences requiring intensive care, hemodynamic collapse
- o. Thrush
  - i. 0--Absent
  - ii. 1--Present

- p. Dyspepsia and/or heartburn
  - i. 0--None
  - ii. 1--Mild
  - iii. 2--Moderate
  - iv. 3--Severe
- 5. Collaborative management for acute effects of cerebral edema
  - a. Steroids: Synthetic glucocorticoids: Dexamethasone or methylprednisolone
    - i. Vasogenic edema from tumor can contribute to neurologic dysfunction.
    - ii. Steroids reduce capillary permeability in as early as one hour after a single dose (Shapiro et al., 1990).
    - iii. Patients improve clinically when steroids are given (Chang et al., 1992).
    - iv. Dexamethasone incompatibilities: Contraindicated with daunorubicin, doxorubicin, metaraminol, and vancomycin (Karch, 2003).
    - v. Standard care is to monitor mucous membrane for oral fungal infections, such as thrush (from steroid use); maintain good oral hygiene (Karch, 2003).
    - vi. Monitor patient for stomach irritation (from steroid use) (Karch, 2003).
  - b. Pain medication for headaches
    - i. The brain is anesthetic. Traction on the dura or the blood vessels within the brain causes headache or pressure (Armstrong & Gilbert, 2000).
    - ii. Headaches develop as a presenting symptom or develop during the course of the disease. Persistent headaches may occur more commonly in patients for whom headaches were a presenting symptom (Levin et al., 2001).
    - iii. Administer medication, as prescribed, for relief of pain.
  - c. Anticonvulsant therapy
    - i. Seizures develop as a consequence of metastatic disease to brain or leptomeninges (Quinn & DeAngelis, 2000).
    - ii. Monitor antiepileptic therapy with serum drug level, liver function, and CBC (Armstrong & Gilbert, 2000).
    - iii. Monitor for skin rash and the more extreme exfoliative rash/toxic epidermal necrolysis (Stevens-Johnson syndrome) with administration of phenytoin (Karch, 2003). Phenytoin is associated with a

reported 20%-30% risk of rash  
(Armstrong, Gilbert, & Movas, 2001).

- iv. Assess for focal neurologic symptoms: Weakness, hemiparesis, hemiplegia, or loss of communication.

#### 6. Patient and family education

- a. Provide written and verbal instructions for signs and symptoms of cerebral edema.
- b. Provide written and verbal instructions for use of steroid and antiepileptic medication; emphasize the importance of maintaining schedule; and do not initiate abrupt cessation of either drug (Karch, 2003).
- c. Instruct patient and family in side effects of prolonged steroid use (Bucholtz, 1997). Also instruct the patient not to abruptly stop taking steroids because of withdrawal side effects; use steroid taper.
  - i. Gastrointestinal: Stomach irritation and abdominal distention. Instructions in use of antacids to be given with steroid dose to prevent peptic ulcers.
  - ii. Endocrine: Increased blood sugar (requires close monitoring of diabetic patients), cushingoid state, growth retardation, menstrual irregularities, and decreased carbohydrate tolerance
  - iii. Fluid and electrolyte disturbance: Sodium retention, potassium loss, hypertension, and moon faces
  - iv. Nervous system: Mood swings, restlessness, insomnia, vertigo, psychoses, headaches, euphoria, intracerebral hemorrhage, cataracts, and increased intraocular pressure
  - v. Dermatologic effects: Acne, impaired wound healing, hirsutism, thin and fragile skin, atrophy, petechiae, and bruising
  - vi. Musculoskeletal: Proximal steroid myopathy (especially thigh muscles, then upper arms) and osteoporosis
  - vii. Infection: Increased susceptibility, especially to Candida; also may mask signs of infection (Karch, 2003)
  - viii. Intracranial tumors: Devastating because of their growth and spread to vital brain centers of emotion, speech, personality, vision, balance, and other neurologic functions that make patients "people" (Strickler & Lipsky-Phillips, 2000). Patients' families need to be aware of

personality changes that occur and report changes to their nurse and physician.

- ix. Long-term steroid use affects the patient's quality of life and self-image as a result of fluid retention, weight gain, leg weakness, insomnia, diabetes, and delayed wound healing. Restrictions on driving, employment, and recreational activities may be mandatory for patients at risk for seizures (Armstrong & Gilbert, 2000).

- 7. Follow-up for cerebral edema includes symptom assessment and neuroimaging (Mendenhall & Moore-Higgs, 2001).

- 8. Tools

- a. Karnofsky Performance Scale: Unidimensional measure of physical functioning (Armstrong & Gilbert, 2000)
- b. Quality-of-life assessments
  - i. Functional Assessment of Cancer Therapy (FACT)-Brain: Measures quality of life in patients undergoing treatment for brain tumors (Weitzner et al., 1995).
  - ii. Mini-Mental Status Evaluation: Includes orientation, registration, attention and calculation, recall, language, and level of consciousness.

- b. Acute alopecia

- 1. Pathophysiology: (Refer to the original guideline document for details)
- 2. Incidence (Refer to the original guideline document for details)
- 3. Assessment
  - a. Scalp evaluation for complications of acute side effects of brain irradiation including dry scalp, radiation dermatitis, hyperpigmentation, and alopecia (Sawaya & Bindal, 1995).
  - b. Use the ONS Radiation Therapy Patient Care Record (Catlin-Huth, Haas, & Pollock, 2002) and the Radiation Therapy Oncology Group (RTOG) grading system for acute and late radiation side effects.
- 4. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - a. Skin sensation
    - i. 0--No problem
    - ii. 1--Pruritus
    - iii. 2--Burning
    - iv. 3--Painful
  - b. Radiation dermatitis
    - i. 0--None
    - ii. 1--Faint erythema or dry desquamation

- iii. 2--Moderate or brisk erythema or patchy moist desquamation, mostly confined to skin folds and creases or moderate edema
    - iv. 3--Confluent moist desquamation >1.5 cm in diameter and not confined to skin folds; pitting edema
    - v. 4--Skin necrosis or ulceration of full thickness dermis; may include bleeding not induced by minor trauma or abrasion
  - c. Alopecia
    - i. 0--Normal
    - ii. 1--Mild hair loss
    - iii. 2--Pronounced hair loss
- 5. Collaborative management for acute effects of alopecia (Goodman, Hilderley, & Purl, 1997)
  - a. Gently wash hair with mild shampoo one to two times a week.
  - b. Use head covering to protect scalp from wind, cold, and sun.
  - c. Apply a sunscreen with a sun protection factor (SPF) 15 or more on face and scalp and cover with a shading hat.
  - d. Use water-soluble lubricant on scalp (see section IV, C—Skin Reactions in the original guideline document).
  - e. Check behind ears in folds for moist desquamation.
  - f. Use a soft-bristle brush to reduce stress on hair shaft.
  - g. Avoid hair dyes and permanents.
- 6. Patient and family education
  - a. Instruct patient that radiation alopecia is limited to the radiotherapy portals. Inform patient that hair thinning usually begins to occur after two to three weeks of treatment (Bucholtz, 1997).
  - b. Hair regrowth takes three to six months (Bucholtz, 1997).
  - c. Hair may return a different color or consistency (Bucholtz, 1997).
  - d. Hair loss may be permanent at a radiation dose of 55 Gy (Bucholtz, 1997).
  - e. Patient education precedes initiation of RT and promotes self-care behaviors and optimal outcomes (Goodman, Hilderley, & Purl, 1997).
  - f. Provide literature regarding wigs (types, where to purchase, insurance reimbursement, wig alternatives).
  - g. Assistance from community-based organizations
    - i. The American Cancer Society, which provides "Look Good . . . Feel Better" program--[www.cancer.org](http://www.cancer.org)
    - ii. American Brain Tumor Association--[www.abta.org](http://www.abta.org)

- iii. Brain Tumor Society--[www.tbts.org](http://www.tbts.org)
- iv. National Brain Tumor Foundation--  
[www.brainumor.org](http://www.brainumor.org)
- v. NCI--<http://www.cancer.gov>

c. Acute radiation myelopathy

1. Pathophysiology (Refer to the original guideline document for details)
2. Incidence (Refer to the original guideline document for details)
3. Assessment (Pearlman & Shaw, 2000)
  - a. Assess patient for Lhermitte's sign in early acute radiation myelopathy.
  - b. Assess CNS alteration for neuropathy (Catlin-Huth, Haas, & Pollock, 2002).
4. Collaborative management of acute effects of myelopathy (Pearlman & Shaw, 2000)
  - a. Instruct patient not to flex head briskly.
  - b. Instruct patient that this syndrome only lasts a few weeks and is not associated with chronic progressive myelitis (Michalski, 2004).
5. Patient and family education
  - a. Adequate preparatory education with sensory and procedural information will reduce the anxiety and fear of the patient with cancer who is facing life-threatening illness (Poroach, 1995).
  - b. Describe signs and symptoms of Lhermitte's sign and avoid neck flexion.
  - c. Stress temporary nature of this side effect.
  - d. Early myelopathy resolves within 6-12 months (Levin et al., 2001).

d. Late radiation myelopathy

1. Pathophysiology (Refer to the original guideline document for details)
2. Incidence (Refer to the original guideline document for details)
3. Assessment/documentation: CNS alteration assessment for neuropathy (Catlin-Huth, Haas, & Pollock, 2002)
4. Collaborative management with urologist and pain management team. Permanent myelopathy is characterized by progressive motor weakness, paresthesias, loss of pain and temperature sensation, loss of bladder control, bowel control, and sensory and motor function loss (Michalski, 2004).
5. Patient and family education
  - a. Instruct family to maintain safe environment.
  - b. Encourage physical therapy for prevention of deep vein thrombosis (DVT) and pneumonia.
  - c. If necessary, instruct family member in urinary catheterization technique, bladder training, or bowel regimen.

- d. Localized spine pain or referred pain must be carefully assessed to rule out epidural spinal cord compression, an oncologic emergency. Pain can be managed, but myelopathy is not reversible (McCaffery & Pasero, 1999).
  - e. Refer to support groups.
- e. Acute somnolence syndrome
  - 1. Pathophysiology (Refer to the original guideline document for details)
  - 2. Incidence (Refer to the original guideline document for details)
  - 3. Assessment (Pearlman & Shaw, 2000)
    - a. Assess for subjective signs and symptoms of sleepiness, sensory changes, lethargy, ataxia, and severe fatigue.
    - b. A positron emission tomography (PET) scan or magnetic resonance imaging (MRI) test may be indicated.
    - c. Level of consciousness and neurologic examination may be necessary.
  - 4. Documentation (Catlin-Huth, Haas, & Pollock, 2002):  
Depressed level of consciousness
    - a. 0--Normal
    - b. 1--Somnolence or sedation not interfering with function
    - c. 2--Somnolence or sedation interfering with function but not interfering with activities of daily living
    - d. 3--Obtundation or stupor; difficult to arouse
    - e. 4--Coma
  - 5. Collaborative management of acute effects of somnolence syndrome--Acute
    - a. Decreases all aspects of patients' quality of life (Armstrong & Gilbert, 2000).
    - b. Administer steroids as prescribed for acute phase.
    - c. A somnolence syndrome of increased fatigue also can appear one to four months after treatment (Sawaya & Bindal, 1995).
  - 6. Patient and family education
    - a. Patient is unable to continue with normal routine of activities of daily living. Role reversal often occurs during this time, including loss of role function within family and workplace (Faithful, 1991). Elevated distress may be observed.
    - b. Worsening of neurologic symptoms and increased tumor edema may be observed.
- f. Radiation necrosis--Late
  - 1. Pathophysiology (Refer to the original guideline document for details)

2. Incidence (Refer to the original guideline document for details)
3. Assessment
  - a. Progression to necrosis usually is observed as a mass lesion producing increased intracranial pressure (Karim, 1995).
  - b. Symptoms
    - i. Visible symptoms of increased intracranial pressure (Catlin-Huth, Haas, & Pollock, 2002)
    - ii. Focal clinical symptomatology (e.g., epilepsy, motor, sensory, speech disturbances) (Karim, 1995)
    - iii. Severe diffuse injury may impair intellectual function causing loss of memory and confusion.
4. Documentation
  - a. Assessment parameters and common toxicity criteria according to the ONS Radiation Therapy Patient Care Record (CNS alteration) (Catlin-Huth, Haas, & Pollock, 2002)
  - b. Diagnostic: Angiography and PET imaging may be necessary to distinguish tumor from radiation necrosis (Schultheiss et al., 1995).
5. Collaborative management
  - a. Steroids reduce capillary permeability and may temporarily reduce symptoms.
  - b. No intervention currently exists to halt or reverse the late effects of RT (Karim, 1995).
6. Patient and family education
  - a. Neurologic changes in patient must be reported.
  - b. Complementary therapies for radiation symptom distress should be reviewed.
    - i. Therapeutic massage may decrease pain, anxiety, and symptom distress; increase relaxation; and enhance comfort and sleep (Smith et al., 2002).
    - ii. Other types of complementary therapies are aromatherapy and music therapy.
    - iii. Support services, such as hospice consultation, may be helpful.
- g. Cerebral atrophy--Late
  1. Pathophysiology (Refer to the original guideline document for details)
  2. Incidence (Refer to the original guideline document for details)
  3. Assessment (Cox, 1994): Clinical manifestations
    - a. Cerebral changes can mimic recurrent tumor with mass effect on computed tomography (CT).
    - b. White matter changes are well defined by MRI studies.
    - c. Recognize symptoms of neurologic deterioration.

4. Documentation
  - a. Assessment parameters and common toxicity criteria according to the ONS Radiation Therapy Patient Care Record (CNS alteration) (Catlin-Huth, Haas, & Pollock, 2002)
  - b. Diagnostic evaluation
5. Collaborative management
  - a. If communicating hydrocephalus is present, a ventriculoperitoneal shunt may be placed.
  - b. Mental status evaluation (Regine et al., 2001)
    - i. Observation and questioning of the patient with a CNS tumor. (Note behavior, affect, facial expressions, timing of answers, orientation, general simple knowledge, questions, memory, and motor function.)
    - ii. The Mini-Mental Status Examination is a tool used for mental status evaluation in patients with brain tumors.
    - iii. RTOG clinical brain studies mandate that essential baseline mental status assessments be done prior to radiation treatments. This first assessment will provide the basic knowledge of the patient's mental status. Neurocognitive morbidity is an important endpoint in RTOG cancer trials.
6. Patient and family education
  - a. Communicate importance of mental status evaluations to patient and family.
  - b. Educate on the importance of safety with developing gait abnormalities.
  - c. See support services for patients with brain tumors.

#### h. Cranial neuropathies--Late

1. Pathophysiology (Refer to the original guideline document for details)
2. Incidence (Refer to the original guideline document for details)
3. Assessment (Gordon, Char, & Sagerman, 1995)
  - a. Optic neuropathies present as a progressive visual loss that may progress to blindness.
  - b. Subjective symptom of hearing loss
  - c. Suggest physical and neurologic exams, including cranial nerve testing.
  - d. Recommend a consultation with ophthalmologist.
  - e. Recommend a consultation for audiogram.
4. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - a. Ocular/visual
    - i. 0--Normal
    - ii. 1--Mild
    - iii. 2--Moderate
    - iv. 3--Severe

- v. 4--Unilateral or bilateral loss of vision
  - b. Middle ear/hearing
    - i. 0--Normal
    - ii. 1--Serous otitis without subjective decrease in hearing
    - iii. 2--Serous otitis or infection requiring medical intervention; subjective decrease in hearing; rupture of tympanic membrane with discharge
    - iv. 3--Otitis with discharge, mastoiditis, or conductive hearing loss
    - v. 4--Necrosis of the canal soft tissue or bone
- 5. Patient and family education
  - a. Written information concerning long-term side effects
  - b. Side effects and safety measures of anticoagulant therapy
  - c. Baseline audiogram
  - d. Enroll in monitoring program
- i. Endocrinopathies--Late
  - 1. Pathophysiology (Refer to the original guideline document for details)
  - 2. Incidence (Refer to the original guideline document for details)
  - 3. Assessment
    - a. Hypothyroid: Cold intolerance, fatigue, constipation, decreased stamina, and weight gain
    - b. Addison's crisis: Amenorrhea, hypertension, and decreased libido
    - c. Diabetes insipidus: Polyuria, polydipsia
    - d. Retarded bone age: Growth hormone deficiency, poor linear growth
    - e. Sexual hormone deficiency or early sexual maturation
    - f. Physical examination
  - 4. Documentation
    - a. Growth and development adverse event: Bone growth, puberty delayed, and stature (NCI, 2003)
    - b. Emotional alteration: Coping (Catlin-Huth, Haas, & Pollock., 2002)
      - i. 0--Effective
      - ii. 1--Ineffective
  - 5. Collaborative management
    - a. Height at three- to six-month intervals to plot on standard growth charts
    - b. Hand x-ray for bone assessment (Sklar & Constine, 1995)
    - c. Thyroid function tests and routine blood studies to exclude major organ dysfunction
  - 6. Patient and family education

- a. Parents need specific written and verbal instructions on the importance of growth hormones.
- b. Patients and their families require information about late effects of treatment. To reduce anxiety and enhance self-care, the information should include presentation, prevalence, and duration of side effects (Wengstrom & Forsberg, 1999).

B. Head and neck

1. Stomatitis/mucositis/pharyngitis/esophagitis (upper one-third esophagus)
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence and risk factors (Refer to the original guideline document for details)
  - c. Assessment
    1. Oral assessment for baseline and a referral to dentistry should occur before treatment begins. Poor oral hygiene and poor dentition should be addressed before initiation of treatment to prevent worsening of problems during and after treatment.
    2. Oral assessment and intervention should occur weekly or more frequently if patient complains of mouth tenderness, pain, or dysphagia. Weekly weights are included in assessment.
    3. Physical examination: Examine lips, tongue, gingiva, and oral cavity for color, moisture, integrity, and presence of stomatitis or infection (see Table 8 in the original guideline document).
    4. Assess whether patient has tracheostomy; metal tracheostomy cannula must be removed during treatment if within the treatment field.
  - d. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
    1. Mucositis due to radiation
      - a. 0--None
      - b. 1--Erythema of the mucosa
      - c. 2--Patchy pseudomembranous reaction (patches generally  $\leq 1.5$  cm in diameter and noncontiguous)
      - d. 3--Confluent pseudomembranous reaction (contiguous patches generally  $> 1.5$  cm in diameter )
      - e. 4--Necrosis or deep ulceration; may include bleeding not induced by minor trauma or abrasion
    2. Thrush (Catlin-Huth, Haas, & Pollock, 2002)
      - a. 0--Absent
      - b. 1--Present
    3. Pharynx and esophagus (Catlin-Huth, Haas, & Pollock, 2002)

- a. 0--No change over baseline
  - b. 1--Mild dysphagia or odynophagia; may require topical anesthetic or non-narcotic analgesic; may require soft diet
  - c. 2--Moderate dysphagia or odynophagia; may require narcotic analgesics; may require puree or liquid diet
  - d. 3--Severe dysphagia or odynophagia with dehydration or weight loss (>15% from pretreatment baseline) requiring gastric feeding tube, IV fluids, or hyperalimentation
  - e. 4--Complete obstruction, ulceration, perforation, or fistula
- 4. Pain location and intensity (Catlin-Huth, Haas, & Pollock, 2002)
  - a. Document location of pain.
  - b. Record patient's subjective rating of degree of pain, with ratings ranging from 0 (no pain) to 10 (severe pain).
- 5. Pain intervention (Catlin-Huth, Haas, & Pollock, 2002)
  - a. 0--None
  - b. 1--Over-the-counter medications
  - c. 2--NSAIDs or nonopioids
  - d. 3--Opioids
  - e. 4--Adjuvant medications (e.g., neuroleptics)
  - f. 5--Complementary and/or alternative methods
- 6. Effectiveness of pain intervention (Catlin-Huth, Haas, & Pollock, 2002)
  - a. 0--No relief
  - b. 1--Pain relieved 25%
  - c. 2--Pain relieved 50%
  - d. 3--Pain relieved 75%
  - e. 4--Pain relieved 100%
- e. Collaborative management of stomatitis/mucositis/pharyngitis/esophagitis
  - 1. Prevention
    - a. Shih et al., 2002 reviewed more than 50 published papers aimed at prevention, palliation, or reduction of RT-induced oral mucositis. Studies involving antimicrobial, coating, and anti-inflammatory agents did not demonstrate decreased severity of radiation-induced oral mucositis. Seven studies that included the use of the cytokine granulocyte macrophage-colony-stimulating factor (GM-CSF) in mouthwashes concluded they may facilitate healing.
    - b. Recommendations for optimal care include (Haas & Kuehn, 2001; Shih et al., 2002; Symonds, 1998)
      - i. Schedule dental evaluation for optimal care of existing teeth or necessary dental extraction before radiation begins.

- Fluoride treatments initiated and continued post-treatment.
  - ii. Avoid irritants such as alcohol, cigarettes, alcohol-based mouthwashes, spicy foods, and rough toothbrushes.
  - iii. Brush teeth and prosthetics with soft toothbrush after each meal and at bedtime.
  - iv. Use saline mouth rinses, lasting one to two minutes, four to six times daily (see section IV, G--Nutrition in the original guideline document).
  - v. Maintain hydration and a diet high in calories and protein. Nutrition supplemental drinks (Ensure® [Ross Laboratories]), Carnation Instant Breakfast® [Nestle, Vevey, Switzerland]) are encouraged.
- 2. Intervention when mouth and throat tenderness occurs (Biron et al., 2000; Haas & Kuehn, 2001; Shih et al., 2002)
  - a. Follow recommendations for optimal care (see section (1) (b) above).
  - b. Perform more frequent mouth assessments to evaluate possible infection. Bacterial and fungal infections should be treated with appropriate medications.
  - c. Assess weight and hydration biweekly. Feeding tube may be necessary if aspiration, hydration, or rapid weight loss are a concern.
  - d. Minimize use of dentures.
  - e. Use a topical anesthetic; swish and spit or swish and swallow are safe recommendations for patients who do not aspirate. When lesions are confined to a limited area, application of anesthetic may be applied with a cotton swab.
  - f. Oral pain medication or pain medication put through a feeding tube should be used to relieve discomfort and pain.
  - g. Recommendation should be made based on patient's ability to swallow, compatibility with other medications, and level of pain. Patients with neutropenia should be warned that anti-inflammatory medication may mask a fever. Suggestions for mild pain include nonopioid analgesics or NSAIDs. Moderate pain can be controlled with medications that include hydrocodone or codeine. Severe pain should be managed with narcotics that include a fentanyl transdermal system (fentanyl), hydromorphone, oxycodone hydrochloride, or morphine sulfate elixir (see section IV, D--Pain in the original guideline document).

- f. Patient and family education
  - 1. Instruct patient and family about oral care regimen and need for routine follow-up with a dentist.
  - 2. Instruct patient on oral assessment and symptoms to monitor and report to the healthcare provider.

## 2. Dysphagia

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment
  - 1. Perform oral assessment for baseline and evaluate range of motion of lips, tongue, and jaw. Assess cough reflex and gag reflex.
  - 2. Refer patient to speech pathologist for swallowing evaluation. The radiographic swallowing evaluation visualizes the timing of the swallowing phases and extent of aspiration. Make a recommendation for a gastrostomy tube if the patient aspirates.
  - 3. Nutritional assessment--Evaluate laboratory values and physical indications of dehydration and malnutrition, and question patient on intake.
  - 4. Pain assessment--Painful swallowing may be related to infection, tumor infiltration, or inflammation from radiation.
  - 5. Swallowing assessment (nonradiologic), pain assessment, and weight should be evaluated weekly during treatment.
- d. Documentation
  - 1. Pharynx and esophagus (Catlin-Huth, Haas, & Pollock, 2002)
    - a. 0--No change over baseline
    - b. 1--Mild dysphagia or odynophagia; may require topical anesthetic or non-narcotic analgesic; may require soft diet.
    - c. 2--Moderate dysphagia or odynophagia; may require narcotic analgesics; may require puree or liquid diet.
    - d. 3--Severe dysphagia or odynophagia with dehydration or weight loss (15% from pretreatment baseline) requiring gastric feeding tube, IV fluids, or hyperalimentation.
    - e. 4--Complete obstruction, ulceration, perforation, or fistula
  - 2. Pain location and intensity (Catlin-Huth, Haas, & Pollock, 2002)
    - a. Document location of pain.
    - b. Record patient's subjective rating of degree of pain, with ratings ranging from 0 (no pain) to 10 (severe pain).
  - 3. Pain intervention (Catlin-Huth, Haas, & Pollock, 2002)
    - a. 0--None

- b. 1--Over-the-counter medications
  - c. 2--NSAIDs or nonopioids
  - d. 3--Opioids
  - e. 4--Adjuvant medications (e.g., neuroleptics)
  - f. 5--Complementary and/or alternative methods
- 4. Effectiveness of pain interventions (Catlin-Huth, Haas, & Pollock, 2002)
  - a. 0--No relief
  - b. 1--Pain relieved 25%
  - c. 2--Pain relieved 50%
  - d. 3--Pain relieved 75%
  - e. 4--Pain relieved 100%
- 5. Thrush (Catlin-Huth, Haas, & Pollock, 2002)
  - a. 0--Absent
  - b. 1--Present
- e. Collaborative management of dysphagia
  - 1. Acute side effects--Goal is to optimize hydration, nutrition, comfort, and swallowing safety.
    - a. Pain management--Treatment of painful oral lesions, xerostomia, and infection will improve swallowing.
    - b. Swallowing therapy and direct swallowing exercises--Fibrosis after radiation occurs (Kendall et al., 1998). Presently, no studies have proven early intervention decreases fibrosis. Intervention with swallowing exercises are encouraged to strengthen musculature, increase range of motion, and develop compensatory strategies.
    - c. Gastrostomy tube should be placed if aspiration occurs or when patient cannot maintain hydration and nutrition.
    - d. Assess patient biweekly or if new complaints emerge during manifestation of acute side effects.
  - 2. Long-term risk for dysphagia--Goal is to optimize swallowing technique. Most patients post-radiotherapy will be able to maintain nutrition without a gastrostomy tube, but the risk for problems with fibrosis exists (Kendall et al., 1998; Vokes et al., 2003). Optimal swallowing interventions include the following.
    - a. Good oral hygiene--Evaluate for good dentition and proper fitting dentures or prosthesis; encourage comfort measures for xerostomia, meticulous oral hygiene, and fluoride treatments; promote and encourage good nutrition.
    - b. Evaluation by swallowing pathologist--Patients with post-treatment dysphagia should be evaluated annually. Evaluation may detect specific problems with dysphagia and encourage preventive measures for safe eating and decreasing fibrosis.
    - c. Long-term follow-up should include an assessment for changes in nutrition intake,

assessment for symptoms of aspiration, and assessment for compliance with exercises and/or swallowing techniques recommended by the swallowing pathologist. A radiographic swallowing study and follow-up with the swallowing pathologist should be ordered when changes in nutrition or complaint of dysphagia are noted.

- f. Patient and family education
  - 1. Instruct patient and family on maintaining good nutrition, managing dysphagia, and the need for follow-up with oncologist and swallowing pathologist.
  - 2. Instruct patient on symptoms of dysphagia/aspiration and which symptoms to monitor and report to the healthcare provider.

### 3. Xerostomia

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment
  - 1. Clinical manifestations: Patient may complain of pain, thick saliva, or dryness (Maher, 2004).
  - 2. Quality of life: Address how the xerostomia is affecting their ability to swallow, eat, taste, speak, and sleep (Haas & Kuehn, 2001). Intimacy may be affected secondary to decreased lubrication when kissing.
  - 3. Physical examination
    - a. Inspect the oral cavity. The mouth may appear dry with furrowing of the tongue. Debris may adhere to the surface. Oral secretions may be thick, ropey, or absent. Assess for signs of infection or irritation from dentures or prosthesis (Maher, 2004).
    - b. Monitor weight. Weight loss may occur because of difficulty eating or swallowing.
- d. Documentation: Salivary gland changes (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. 0--None
  - 2. 1--Slightly thickened saliva; may have slightly altered taste; additional fluids may be required.
  - 3. 2--Thick, ropey, sticky saliva; markedly altered taste; alterations in diet required.
  - 4. 3--
  - 5. 4--Acute salivary necrosis
- e. Collaborative management of xerostomia
  - 1. Prevention
    - a. Intensity-modulated radiotherapy (IMRT)--When a radiation facility is able to treat patients with head and neck cancer with IMRT, the incidence of xerostomia can be significantly reduced. Chao et al. (2001) reviewed 430 patients who received radiation for oropharynx cancer. Conclusion:

Patients treated without IMRT, 60%-75%, experienced grade II or higher chronic xerostomia. Oropharynx radiation treatments using IMRT, 17%-30%, had chronic xerostomia of grade II or higher.

- b. Radiotherapy protectant--Brizel et al. (2000) reported a randomized study of 315 patients, half of whom received radiation only and half of whom received radiation and amifostine. At one-year follow-up, chronic xerostomia occurred in 34% of patients who received amifostine versus 57% in those who did not receive amifostine (see section IX, B--Radioprotectors in the original guideline document).
  - c. Pilocarpine is a cholinergic drug that acts at the level of receptors that have the potential to increase saliva from residual salivary glands. Guchelaar, Vermes, & Meerwaldt, 1997 reported it to be effective in increasing salivary flow and reducing the symptom of xerostomia. It should be used with caution in patients with other comorbidities, and if ineffective after several months, the drug should be discontinued.
2. Acupuncture for chronic xerostomia--Johnstone, Niemtow, and Riffenburgh (2002) reported a 68% response rate, and Blom et al., 1996 reported that many patients experienced thinner saliva and improved taste. Both studies delivered acupuncture using different techniques. Blom and Lunderberg (2000) concluded that 24 acupuncture treatments resulted in improvement up to six months; patients who continued with acupuncture, at three-year follow-up, maintained improvement.
  3. Therapeutic self-care measures (Maher, 2004)
    - a. Take frequent sips of water.
    - b. Perform mouth care before and after meals and at bedtime to refresh the mouth and make eating more comfortable.
    - c. Avoid mouthwashes with alcohol. Normal saline mouth rinse is recommended.
    - d. Soft, moist foods are easier to consume. Avoid dry and sticky foods.
    - e. Commercial artificial saliva substitutes and lubricants may provide relief.
    - f. Add humidity to environment, especially the bedroom.
    - g. Use of sugar-free hard candy and gum may increase saliva production.
    - h. Cigarette smoking and alcohol consumption will enhance xerostomia. Educate patient about cessation and seeking support for addiction.
    - i. Recommendations, without evidence, include papaya juice (liquefies thick saliva), rinse and expectorate solution of meat tenderizer and

water (dissolves thick saliva), and smear olive oil on tongue before bedtime.

4. Therapeutic measures involving a dentist (Maher, 2004)
  - a. Fluoride treatments are a lifelong recommendation for prevention of tooth decay. The dentist may provide fluoride trays.
  - b. Evaluate dentures/prosthesis. If irritation is problematic, refer to dentistry and limit use.
  - c. Frequent follow-up (three to four times per year) with dentistry for optimal dental health
- f. Patient and family education
  1. Teach family about xerostomia and how to alleviate dryness and prevent injury to fragile mucosa.
  2. Instruct patient and family that xerostomia may be a permanent side effect, and meticulous care is a lifelong recommendation.

#### 4. Taste changes

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment
  1. Clinical manifestations
    - a. Patient reports taste changes.
    - b. Assess the type of taste change experienced. Can patient taste sweet, salty, sour, and bitter?
    - c. Note foods that are avoided or not eaten.
  2. Physical examination
    - a. Monitor weight
    - b. Examine mouth
- d. Documentation: Taste disturbances (Catlin-Huth, Haas, & Pollock, 2002)
  1. 0--Normal
  2. 1--Slightly altered
  3. 2--Markedly altered
- e. Collaborative management of taste changes
  1. Intervention with zinc sulfate
    - a. Ripamonti et al., 1998 conducted a randomized study with zinc sulfate tablets or placebo with patients receiving radiation for head and neck cancer.
    - b. Zinc sulfate administration slowed down the worsening and accelerated the improvement of taste acuity in a clinically and statistically relevant way for some of the taste qualities.
  2. Therapeutic measures from the American Cancer Society, 2002 include
    - a. Rinse mouth with tea, ginger ale, salt water, or water with baking soda before eating to help clear the taste buds.
    - b. Flavor foods with onion, garlic, mustard, and herbs. If stomatitis is resolved, may use ketchup,

- barbecue sauce, citrus fruits, vinegar, and chili powder.
  - c. Increase the sugar in foods to increase their pleasant taste and decrease salty, bitter, or acid tastes.
  - d. Lemon drops, mints, or gum may help rid unpleasant tastes that linger after eating.
  - e. Serve foods cold or at room temperature. This can decrease the foods' tastes and smells, making them easier to tolerate.
  - f. Freeze and eat foods such as cantaloupe, grapes, oranges, and watermelon.
  - g. Fresh vegetables may be more appealing than canned or frozen.
- f. Patient and family education
  1. Instruct patient and family about taste changes, when and how long they may last.
  2. Teach patient and family measures on how to cope with taste changes.
    - a. Explain that taste changes may be long-lasting. Return of taste is individualized.
    - b. Nutritional intake should be monitored to prevent weight loss.

5. Laryngitis--Changes in voice quality

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment
  1. Clinical manifestations--Note voice quality before, during, and after treatment. Assess level of hoarseness.
  2. Physical examination--Indirect laryngoscopy reveals vocal cord edema, erythema, and paralysis.
- d. Documentation: Voice changes/stridor/larynx (Catlin-Huth, Haas, & Pollock, 2002)
  1. 0--Normal
  2. 1--Mild or intermittent hoarseness
  3. 2--Persistent hoarseness but able to vocalize; may have mild to moderate edema.
  4. 3--Whispered speech, not able to vocalize; may have marked edema.
  5. 4--Marked dyspnea/stridor requiring tracheostomy or intubation
- e. Collaborative management
  1. Avoid straining the voice to minimize irritation to the vocal cords.
  2. Avoid use of alcohol, tobacco, and spicy and acidic foods.
  3. Warm saline gargle can be soothing.
  4. Consult pain management if needed.
  5. Occasionally, steroids or alpha-adrenergic agents may become necessary if edema becomes severe. In rare

instances, a tracheostomy is necessary because of airway compromise (Haas & Kuehn, 2001).

- f. Patient and family education
  - 1. Instruct patient and family on measures to preserve voice and soothe throat.
  - 2. Instruct patient and family regarding symptoms of airway obstruction and how to get emergency care.

6. Hearing changes

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment (Andresen et al., 1998)
  - 1. Clinical manifestations: Decreased hearing acuity is reported.
  - 2. Physical examination
    - a. Inspect the ear canal and, using an otoscope, note the presence of ear wax and debris. A tuning fork may be used to assess for air and bone conduction.
    - b. The tympanic membrane should appear opalescent; if the membrane appears bulging, erythematous, or punctured or if drainage or blood is present, an otolaryngologist needs to perform a further evaluation.
- d. Documentation of hearing changes (Bruner et al., 1998)
  - 1. 0--None
  - 2. 1--Mild tinnitus; slightly reduced hearing
  - 3. 2--Moderate tinnitus; moderately reduced hearing
  - 4. 3--Hearing loss interfering with function but correctable with hearing aid and/or medications
  - 5. 4--Complete hearing loss
- e. Collaborative management
  - 1. Administer pseudoephedrine, as directed, if fluid has accumulated in the middle ear.
  - 2. Administer antibiotics, as directed, for ear infections.
  - 3. Arrange for immediate evaluation with an otolaryngologist if any sudden, acute hearing loss occurs.
  - 4. Arrange for removal of cerumen by trained staff in otolaryngology.
- f. Patient and family education
  - 1. Instruct patient and family to monitor for hearing changes.
  - 2. Advise patient to report any sudden, acute changes in hearing immediately.

7. Osteoradionecrosis (ORN)

- a. Pathophysiology (Refer to the original guideline document for details)

- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment
  - 1. Evaluate risk factors
  - 2. Clinical manifestations
    - a. Oral, jaw, or facial pain
    - b. Mandibular fracture
  - 3. Physical examination
    - a. Assess oral cavity, especially the condition of the teeth and buccal mucosa.
    - b. Assess for infection, nonhealing wounds, and condition of mandible.
- d. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. Pain location and intensity
    - a. Document location of pain.
    - b. Record patient's subjective rating of degree of pain, with ratings ranging from 0 (no pain) to 10 (severe pain).
  - 2. Pain intervention
    - a. 0--None
    - b. 1--Over-the-counter medications
    - c. 2--NSAIDs or nonopioids
    - d. 3--Opioids
    - e. 4--Adjuvant medications (e.g., neuroleptics)
    - f. 5--Complementary and/or alternative methods
  - 3. Effectiveness of pain interventions
    - a. 0--No relief
    - b. 1--Pain relieved 25%
    - c. 2--Pain relieved 50%
    - d. 3--Pain relieved 75%
    - e. 4--Pain relieved 100%
- e. Collaborative management of ORN (acute and long-term)
  - 1. Prevention
    - a. Consult with dentistry prior to radiation to optimize oral health and repair poor-fitting oral/dental prosthesis.
    - b. Administer antibiotics as prescribed for oral infections and prior to extractions.
    - c. Continue meticulous oral care and use of fluoride to prevent dental caries.
    - d. Instruct patient to minimize oral irritants
    - e. Maintain good nutritional status
  - 2. Intervention when ORN occurs
    - a. Conservative modalities include saline irrigations, antibiotics during infectious periods, and topically applied antiseptics (Jereczek-Fossa & Orecchia, 2002).
    - b. When conservative measures are not effective, intervention to remove loosened bone elements and treatment with hyperbaric oxygen is effective. Radical surgery is reserved for persistent ORN.

- c. Successful surgery includes using hyperbaric oxygen pre- and postoperatively and resection of the mandible with reconstruction, often using the tibia (Aitasalo et al., 1998; Jereczek-Fossa & Orecchia, 2002).
- f. Patient and family education
  - 1. Instruct patient and family about ORN, including risk factors, signs and symptoms, and measures of prevention.
  - 2. Instruct patient and family to continue meticulous mouth care and routine evaluations by dentistry.

## 8. Trismus

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence and risk factors (Refer to the original guideline document for details)
- c. Assessment
  - 1. Clinical manifestations
    - a. Patient reports difficulty opening mouth.
    - b. Patient reports difficulty chewing.
  - 2. Physical examination: Ability to open mouth is limited.
- d. Documentation
  - 1. Assessment for trismus is performed by measuring the amount of millimeters a patient can open the mouth.
  - 2. Effectiveness of intervention for trismus is documented by recording the changes in number of millimeters a patient can open the mouth. Patients' comments regarding ability to chew are a measurement of treatment effectiveness.
- e. Collaborative management of trismus
  - 1. Prevention: Encourage patient to exercise mouth regularly with chewing exercises to prevent fibrosis (Haas & Kuehn, 2001).
  - 2. Interventions when trismus occurs
    - a. Consult with a physical therapist and speech therapist for evaluation of a supplemental device to expand movement. Therabite® (Atos Medical Corporation, Milwaukee, WI) and E-Z Flex® (Fluid Motion Biotechnologies, Columbia, New York) are two recommendations. Buchbinder et al., 1993 reported improvement with the Therabite system as compared to unassisted exercise and exercise with tongue blades. E-Z Flex is a newer device with no comparison data in the literature. E-Z Flex is based on a hydraulic approach to mobilization but does not apply the same amount of force to the jaw as Therabite.
    - b. Encourage the intake of nutritional supplements while patient has trismus.
- f. Patient and family education
  - 1. Inform patient and family regarding risks for trismus and to report changes in mouth mobility.

2. Instruct patient and family about mouth and chewing exercises to prevent fibrosis.

9. Skin reactions (see below and section IV, C--Skin Reactions in the original guideline document)

C. Breast

1. Skin reactions

- a. Definition (Refer to the original guideline document for details)
- b. Pathophysiology (Refer to the original guideline document for details)
- c. Incidence (Refer to the original guideline document for details)
- d. Assessment

1. Pretreatment skin status

- a. Assess for evidence of surgical wound breakdown, rashes, or areas that appear irritated from clothing.
- b. Conduct global assessment for evidence of non-treatment-related factors that may increase risk of skin reactions, including age, nutritional status, presence of coexisting disease, drug therapy, chemotherapy, smoking (impaired oxygenation), skin color and condition, ultraviolet (UV) exposure (skin only), and site (Porock, 2002).

2. Careful visual examination of the skin within the treatment fields (including exit sites) should be performed once a week during treatment and during regular follow-up examinations.

- e. Documentation (Catlin-Huth, Haas, & Pollock, 2002)

1. Skin sensation

- a. 0--No problem
- b. 1--Pruritus
- c. 2--Burning
- d. 3--Painful

2. Radiation dermatitis

- a. 0--None
- b. 1--Faint erythema or dry desquamation
- c. 2--Moderate to brisk erythema or patchy moist desquamation, mostly confined to skin folds and creases; or moderate edema
- d. 3--Confluent moist desquamation  $\geq$  1.5 cm diameter and not confined to skin folds; pitting edema
- e. 4--Skin necrosis or ulceration of full-thickness dermis; may include bleeding not induced by minor trauma or abrasion

3. Comfort alteration (pain) also should be assessed on a scale of 0 (no pain) to 10 (severe pain)

4. Drainage (Catlin-Huth, Haas, & Pollock, 2002)

- a. 0--Absent
  - b. 1--Present
- 5. Drainage odor (Catlin-Huth, Haas, & Pollock, 2002)
  - a. 0--Absent
  - b. 1--Present
- f. Collaborative management for skin reactions
  - 1. Acute effects
    - a. Prevention
      - i. Identify factors that may increase the skin reaction, and take measures to reduce impact of each factor.
      - ii. Use special positioning devices to reduce appositional skin folds.
      - iii. Delay treatment until surgical wound has completely healed.
      - iv. Obtain a nutritional evaluation by a dietitian, if needed.
      - v. Obtain an evaluation by an internist to maximize stability of comorbid disease, especially diabetes.
      - vi. If skin integrity is compromised by the presence of tumor in the treatment field, a plan should be initiated for minimizing further trauma and irritation, preventing infection, absorbing exudate, and decreasing odor.
    - b. Intervention
      - i. Dry desquamation
        - A number of products have been used to prevent and treat acute skin reactions (see section IV, C--Skin Reactions in the original guideline document). Biafine® may delay or prevent reactions in large-breasted women (Fisher et al., 2000).
        - Avoid lotions that contain heavy metal. Avoid having lotion on skin during the radiation treatment, as the lotion can increase skin reaction. Remove excess lotion with a soft washcloth before treatment.
      - ii. Pruritus: The following interventions may be helpful (McDonald, 1992; Wickline, 2004).
        - Dry cornstarch (controversial) (see section IV, C—Skin Reactions in the original guideline document)
        - Oatmeal colloidal soap applied to the affected area for 5-10 minutes and then rinsed

- Oatmeal colloidal lotion applied after treatment and before bed
  - Pure aloe gel applied after treatment and before bed
  - Mild topical steroid applied once a day
- iii. Moist desquamation: The treatment of moist desquamation has changed as a result of the research available on wound healing.
- Current wound healing policy is to support the wound with protective dressing and moisture rather than to leave the wound to air dry.
  - Several key factors must be considered before selecting a wound care plan for an individual patient.
    - Size and site of the wound
    - Presence of infection
    - Radiation treatment plan
    - Ability of the patient to comply with wound care plan
  - Cleanse the wound.
    - Small bleeding points can be controlled with silver nitrate sticks.
    - Apply wound care products.
    - For patients who are continuing with treatment, use a product that absorbs and does not provide a "bolus" effect (e.g., hydroactive gels [95% water with 5% gel-forming polymers]).
    - For patients who are not continuing with treatment, use a product that provides moisture with or without an antibacterial or antifungal effect (e.g., silver sulfadiazine [effective against gram-positive and gram-negative organisms and *Candida albicans*]).
  - Apply protective dressing. A nonstick absorbent dressing (e.g., Exu-Dry® [Smith & Nephew, Largo, FL], telfa pad) should be applied. A hydrocolloid, occlusive, and moisture vapor-permeable

dressing may be used. However, they must be removed before daily treatment and therefore may cause more desquamation and pain.

- Treat infection if present.
- Control pain with appropriate medication.
- If tumor is present in the wound, a chronic wound care program should be initiated that includes cleansing the wound, debridement, controlling bleeding, controlling odor, protecting the wound from further damage, and controlling pain.
- Metronidazole 0.8% gel, charcoal dressings, a suspension of aluminum hydroxide/magnesium hydroxide, or yogurt may be applied to the wound to reduce the odor. Silver nitrate sticks or a sucralfate paste (1 g sucralfate tablet crushed into 2-3 ml of hydrogel) may reduce oozing sites of blood. If dressings become stuck to the wound, soak them off with normal saline.
- Aluminum hydroxide/magnesium hydroxide suspension or yogurt applied to an ulcerated area often will relieve burning sensations (Waller & Caroline, 1996).

2. Late effects: Late skin reactions progress slowly and subclinically from six months to many years later. Each patient needs an individualized plan to improve skin texture and elasticity as well as to reduce risks for trauma.

a. Prevention and intervention

i. Skin texture and elasticity

- Apply moisturizing lotion that includes vitamin E or aloe vera gel to the treatment field at least once a day.
- Avoid exposure to the sun or generously apply an appropriate sunscreen and repeat during sun exposure.
- Initiate physical therapy with gentle massage or myofascial release to increase elasticity and reduce fibrosis and scar formation.

ii. Reduce risk for trauma

- Avoid activities that increase risk of skin break or bruising.
  - Avoid scratching, the use of adhesive tape, and other activities that increase skin friction.
- b. If skin breakdown or necrosis occurs, a local recurrence of the cancer should be ruled out before referral to a chronic wound care specialist.
- g. Patient and family education (Refer to the original guideline document for details)

## 2. Lymphedema

- a. Definition (Refer to the original guideline document for details)
- b. Pathophysiology (Refer to the original guideline document for details)
- c. Incidence and risk factors (Refer to the original guideline document for details)
- d. Assessment
  - 1. Measure bilateral circumference at standard points at each follow-up visit (i.e., 10 cm above and below the alcrenon) (Petrek, Pressman, & Smith, 2000)
  - 2. Lymphedema develops in a number of stages, from mild to severe (referred to as stages 1, 2, and 3) (Thiadens, 2000).
    - a. Stage 1 (spontaneously reversible): Tissue is still at the "pitting" stage, which means that when pressed by fingertips, the area indents and holds the indentation. Usually, upon waking in the morning, the limb(s) or affected area is normal or almost normal size.
    - b. Stage 2 (spontaneously irreversible): The tissue now has a spongy consistency and is "nonpitting," meaning that when pressed by fingertips, the tissue bounces back without any indentation forming. Fibrosis found in stage 2 lymphedema marks the beginning of the hardening of the limbs and increasing size.
    - c. Stage 3 (lymphostatic elephantiasis): At this stage, the swelling is irreversible and usually the limb(s) is/are very large. The tissue is hard (fibrotic) and unresponsive; some patients consider undergoing reconstructive surgery called "debulking" at this stage.
- e. Documentation
  - 1. Measurements of both arms on patient care record (Catlin-Huth, Haas, & Pollock, 2002)
  - 2. Lymphatics (NCI, 2003)
    - a. 0--None
    - b. 1--Mild lymphedema
    - c. 2--Moderate lymphedema requiring compression; lymphocyst

- d. 3--Severe lymphedema limiting function; lymphocyst requiring surgery
  - e. 4--Severe lymphedema limiting function with ulceration
- f. Collaborative management of lymphedema
  - 1. Compression garment--An elastic sleeve or ReidSleeve® (Peninsula Medical Supply, Scotts Valley, CA) worn on the affected arm to encourage fluid to move out of the arm.
  - 2. Complex decongestive therapy (CDT)--This therapy includes (National Lymphedema Network [NLN], 2004)
    - a. Manual lymphatic drainage--A gentle massage that stimulates collateral lymphatic channels to move the fluid out of the arm
    - b. Compression bandaging--Helps lymph flow and prevents refilling of the arm between treatment sessions while encouraging the skin to reshape to a smaller size
    - c. Individualized exercise program--Used with compression bandaging to help lymphatic drainage and build strength, flexibility, endurance, and function
    - d. Patient education--About skin care, self-massage, diet, exercise, and continued prevention methods
  - 3. Assess and manage signs/symptoms of lymphangitis (infection) in the arm, shoulder, or breast, including rash; red, blotchy skin or discoloration of the skin; itching of the arm, under the arm, or breast; increased swelling; skin feels warmer than the other side; heavy sensation in the arm (more so than usual); pain, and in some cases, high fever and chills (National Lymphedema Network, 2004).
- g. Patient and family education (Refer to the original guideline document for details)

### 3. Brachial plexopathy

- a. Definition (Refer to the original guideline document for details)
- b. Pathophysiology (Refer to the original guideline document for details)
- c. Incidence and risk factors (Refer to the original guideline document for details)
- d. Assessment: Symptoms typically occur in an upper trunk distribution, with weakness of the arm flexors and shoulder abductors (Wilburn, 1993).
  - 1. Paresthesias
  - 2. Hyperthesias
  - 3. Pain
  - 4. Weakness
- e. Documentation
  - 1. Sensory changes
  - 2. Functional changes
  - 3. Pain
- f. Collaborative management of brachial plexopathy

1. Provide pain control.
    2. If related to tumor compression, treatment with either local (radiation) or systemic therapy (chemotherapy or hormonal therapy)
    3. Consult with physical therapist for arm/shoulder mobilization exercises.
  - g. Patient and family education
    1. Provide patient and family with information about signs and symptoms of brachial plexopathy.
    2. Inform patient and family about potential injury resulting from changes in sensory and motor function.
4. Second malignancies
- a. Definition (See original guideline document for details)
  - b. Pathophysiology (See original guideline document for details)
  - c. Incidence and risk factors (See original guideline document for details)
  - d. Assessment
    1. Family history
    2. Lifestyle risk factors currently under investigation
      - a. Smoking
      - b. Diet
      - c. Alcohol
  - e. Documentation: Document assessment findings.
  - f. Collaborative management for second malignancies
    1. Follow American Cancer Society guidelines for recommending routine screening studies, including mammograms, Pap smears, chest x-rays, and colonoscopy.
    2. Refer for genetic counseling, if appropriate.
  - g. Patient and family education
    1. Instruct patient on the importance of routine follow-up care including breast self-examination, clinical breast examination, and mammogram as a means of early detection of second malignancy.
    2. Counsel patient on lifestyle behaviors to prevent other primary malignancies (e.g., smoking, diet/weight control).
5. Breast edema
- a. Definition (Refer to the original guideline document for details)
  - b. Pathophysiology (Refer to the original guideline document for details)
  - c. Incidence and risk factors (Refer to the original guideline document for details)
  - d. Assessment
    1. Physical examination
    2. Careful inspection for evidence of erythema, skin changes (similar to peau d'orange), warmth, and/or discoloration of the breast that may indicate cellulitis.
  - e. Collaborative management of breast edema

1. Referral to massage therapist or lymphedema program for gentle tissue massage of the breast or chest wall, shoulder, and axilla.
  2. Use of a compression bra designed to reduce edema, such as the Compressure Comfort Bra.
  3. Intermittent aches and pains in the treated breast is a common acute side effect that can be managed with NSAIDs.
  - f. Patient and family education
    1. Educate the patient on the importance of wearing a supportive bra or compression bra to reduce the edema.
    2. Teach the patient the signs and symptoms of infection, including erythema, warmth, and increased swelling.
6. Rib fracture
- a. Definition (Refer to the original guideline document for details)
  - b. Pathophysiology (Refer to the original guideline document for details)
  - c. Incidence and risk factors (Refer to the original guideline document for details)
  - d. Assessment
    1. Symptoms may include chest wall pain with deep respiratory inspiration and/or cough, pain with movement, or sudden onset of chest wall pain. Low-grade fever is observed in patients with pneumonitis.
    2. X-ray of the ribs
  - e. Collaborative management of rib fracture: Pain management
  - f. Patient and family education
    1. Educate the patient on the importance of avoiding activities that include pressure against the chest wall, such as contact sports.
    2. Teach the patient appropriate sitting and lying positions that can reduce the pain associated with the rib fracture.
    3. Educate the patient on the signs and symptoms that should be reported immediately, including sudden shortness of breath, hemoptysis, or worsening pain.
7. Cardiac toxicity
- a. Incidence: RT has been associated with an increased risk of cardiac mortality and morbidity in early-stage left-sided breast cancer. The anterior left ventricle is frequently included in the treatment fields (Mendenhall, Fletcher & Million, 1991). Cardiac mortality has been found to positively correlate with cardiac dose-volume (Gyenes et al., 1998).
  - b. Patients who receive high dose-volumes appear to have an increased mortality from ischemic heart disease but not myocardial infarctions (Gyenes et al., 1998). With modern technology, including CT simulation, it is possible to decrease the volume of heart in the irradiation of the left breast. Immobilization devices are used to passively "shift" the heart out of place to minimize the heart exposure.

## 8. Pulmonary toxicity

- a. Incidence--Pulmonary complications following radiation for breast cancer are related to radiation dose, technique, and volume of lung included in the treatment field. Depending on patient anatomy and treatment technique, a variable amount of lung is always irradiated when the breast, chest wall, or regional lymphatics are treated (Mendenhall, Fletcher & Million, 1987).
- b. Acute pneumonitis is more likely when larger volumes of lung are irradiated (see section V, D--Thoracic below and in the original guideline document). Asymptomatic pulmonary fibrosis, limited to the treatment volume, usually is seen on chest x-ray and CT imaging, including the apical region when the supraclavicular/axillary region is irradiated (see section V, D--Thoracic below and in the original guideline document).

## D. Thoracic

### 1. Radiation pneumonitis and fibrosis

- a. Definition (Refer to the original guideline document for details)
- b. Pathophysiology (Refer to the original guideline document for details)
- c. Incidence and risk factors (Refer to the original guideline document for details)
- d. Assessment of pneumonitis
  1. Clinical manifestations (Abratt & Morgan, 2002)
    - a. Occur up to three months after a fractionated course of irradiation
    - b. Symptoms usually resolve in six to eight weeks without any long-term effects.
    - c. Symptoms may include
      - i. Nonproductive cough
      - ii. Low-grade fever
      - iii. Tachycardia
      - iv. Dyspnea
      - v. Pleuritic chest pain
  2. Physical examination
    - a. Low-grade fever
    - b. Shortness of breath
    - c. Nonproductive cough
    - d. Blood-tinged sputum
    - e. Consolidation in region corresponding to radiation field, although less evident as area contracts with fibrosis (Cox & Komaki, 1994; McDonald et al., 1995).
    - f. Tachycardia
  3. Radiographic findings (McDonald et al., 1995)
    - a. Chest x-ray--Diffuse infiltrate corresponding to the RT field. Not always evident.

- b. CT scan--Evidence of increased lung density and discrete and solid consolidation in corresponding RT field
  - 4. Pulmonary function studies (Abratt & Morgan, 2002).
    - a. Most objective evaluation of the functional late effects of radiation lung toxicity
    - b. No gross abnormalities for four to eight weeks after treatment
    - c. The volume of lung irradiated may affect the pattern of decreases of the different lung volumes.
    - d. Measurements need to include both lung volumes and the transfer factor (diffusion capacity of the lung for carbon monoxide).
- e. Assessment of fibrosis
  - 1. Clinical manifestations
    - a. Can occur 6-12 months after treatment is completed (Nicolaou, 2003)
    - b. Symptoms are proportional to the extent of lung parenchyma involved and the preexisting pulmonary reserve.
    - c. Symptoms are minimal if fibrosis is limited to <50% of one lung.
    - d. Fibrosis develops insidiously and usually stabilizes in one to two years
    - e. If symptoms are present, they are usually dyspnea associated with progressive chronic cor pulmonale.
  - 2. Physical examination
    - a. Tachypnea
    - b. Dyspnea
  - 3. Radiographic findings
    - a. Scarring and reduction of lung volume (Abratt & Morgan, 2002)
    - b. Retraction of the involved lung with elevation of the hemidiaphragm is the predominant finding (Nicolaou, 2003).
    - c. CT imaging is the preferred study.
  - 4. Pulmonary function studies
    - a. May show mild deterioration as fibrosis develops
    - b. Maximum breathing capacity reduced
- f. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. Cough
    - a. 0--Absent
    - b. 1--Mild, relieved by nonprescription medication
    - c. 2--Requiring narcotic antitussive
    - d. 3--Severe cough or coughing spasms, poorly controlled or unresponsive to treatment
  - 2. Hemoptysis

- a. 0--None
    - b. 1--Specks of blood in mucus
    - c. 2--Pink-tinged mucus
    - d. 3--Small clots of blood in mucus
    - e. 4--Frank blood in mucus
  - 3. Mucus color
    - a. 0--Clear
    - b. 1--White
    - c. 2--Yellow
    - d. 3--Green
    - e. 4--Brown
    - f. 5--Red (hemoptysis)
  - 4. Dyspnea
    - a. 0--Normal
    - b. 1--Dyspnea on exertion
    - c. 2--Dyspnea at normal level of activity
    - d. 3--Dyspnea at rest or requiring ventilator support
  - 5. O<sub>2</sub> saturation level
- g. Collaborative management
- 1. Prevention: The use of cytoprotective agents such as amifostine may reduce radiation-induced lung toxicity (Antonadou et al., 2001; Komaki et al., 2002; Vujaskovic et al, 2002) (see section IX, B--Radioprotectors below and in the original guideline document).
  - 2. Interventions
    - a. Corticosteroids: Corticosteroids remain the treatment of choice for radiation pneumonitis. They provide symptomatic relief, do not reverse or prevent fibrosis, and may be contraindicated.
    - b. Bronchodilators
    - c. Expectorants, humidifier, increased hydration, antitussives
    - d. Bed rest
    - e. Supplemental oxygen
    - f. Delanian et al., 2003 suggested that six months of pentoxifylline and tocopherol (vitamin E) may stimulate the regression of superficial radiation-induced fibrosis.
  - 3. Management of other symptoms
    - a. Fatigue (see section IV, B--Fatigue above and in the original guideline document)
    - b. Anorexia (see section IV, G--Nutrition above and in the original guideline document)
  - 4. Coordination of symptom management
    - a. Share information about symptom management (e.g., home health, medical oncology, hospice) with all nurses caring for the patient.
    - b. Provide a safe home environment through continuity of care.
  - 5. Patient and family education
    - a. Acute

- i. Inform patient and family about interventions to manage cough and shortness of breath.
  - ii. Teach patient and family the signs and symptoms of pneumonitis.
  - iii. Instruct patient to alternate rest and activity.
  - iv. Advise patient to avoid irritants (e.g., tobacco, pollutants).
  - v. Teach patient and family signs and symptoms (e.g., fever, cough, dyspnea) to report to the healthcare team.
  - vi. Provide written steroid taper instructions for the patient to follow.
- b. Late
  - i. Teach patient and family signs and symptoms of fibrosis.
  - ii. Teach patient and family methods to avoid further respiratory compromise.

## 2. Radiation myelopathy

- a. Definition (Refer to the original guideline document for details)
- b. Pathophysiology (Refer to the original guideline document for details)
- c. Incidence and risk factors (Refer to the original guideline document for details)
- d. Assessment
  - 1. Clinical manifestations: Symptoms may develop after a latent period from six months and on (Schultheiss et al., 1995). They may be subtle initially. Severity of symptoms is often progressive.
    - a. Paresthesia or sensory deficits (either unilateral or bilateral)
    - b. Leg weakness
    - c. Clumsiness
    - d. Diminished proprioception
    - e. Lhermitte's sign may precede permanent myelopathy.
    - f. Paralysis
    - g. Bladder or anal dysfunction/incontinence
  - 2. Physical examination (Schultheiss et al., 1995)
    - a. Complete neurologic examination
    - b. Patterns of paresthesias
    - c. Upper or lower extremity weakness
    - d. Gait spasticity (foot drop)
    - e. Hemiparesis
    - f. Brown Sequard syndrome
    - g. Pain
    - h. Hyperreflexia and Babinski reflex often are found.
  - 3. Radiographic findings
    - a. CT scan--Rarely abnormal (Schultheiss et al., 1995)

- b. MRI--May show cord swelling with decreased intensity of T1-weighted images and increased intensity on T2-weighted images (Wang, Shen, & Jan, 1992)
- 4. Other studies
  - a. Myelogram--May be normal or may show slight widening of the spinal cord (Schultheiss et al., 1995)
  - b. Cerebral spinal fluid--Usually normal. May have a slight elevation of total protein, basic protein, and lymphocytes (Paulson & Quenemoen, 1984)
  - c. Nerve conduction studies--Decreased spinal conduction velocities (Dorfman et al., 1982; Snooks & Swash, 1985)
- e. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. Neuropathy--Motor
    - a. 0--Normal
    - b. 1--Subjective weakness but no objective findings
    - c. 2--Mild objective weakness interfering with function, but not with activities of daily living
    - d. 3--Objective weakness interfering with activities of daily living
    - e. 4--Paralysis
  - 2. Ataxia
    - a. 0--Absent
    - b. 1--Present
  - 3. Urinary incontinence
    - a. 0--Absent
    - b. 1--Present
  - 4. Bowel incontinence
    - a. 0--Absent
    - b. 1--Present
  - 5. Additional evaluations may include sensory (numbness), sphincter control, pain, and neurologic function.
- f. Collaborative management for radiation myelopathy
  - 1. Prevention: Careful dose calculation and administration of RT
  - 2. Interventions
    - a. Evaluate for other etiologies, including tumor progression, infection, or trauma.
    - b. Administer corticosteroid.
    - c. Provide a referral to rehabilitation in an attempt to maximize function.
- g. Patient and family education
  - 1. Educate patient and family on neurologic symptoms to report.
  - 2. Instruct patient on injury prevention secondary to neurologic and sensory deficits, including fall prevention.
  - 3. Instruct patient and family on corticosteroid administration and taper as well as potential side effects.

4. Progression of symptoms depends upon the degree to which the lesion transects the spinal cord and the level of injury.
3. Cardiac injury
    - a. Definition (Refer to the original guideline document for details)
    - b. Pathophysiology (Refer to the original guideline document for details)
    - c. Incidence and risk factors (Refer to the original guideline document for details)
    - d. Assessment
      1. Clinical manifestations
        - a. Shortness of breath
        - b. Chest pain
        - c. Fatigue
        - d. Lower extremity swelling
        - e. Syncope
      2. Physical examination
        - a. Arrhythmias
        - b. Altered respiratory status
        - c. Lower extremity edema
      3. Cardiac function studies
        - a. Electrocardiogram (EKG)
        - b. Resting echocardiograph and/or exercise echocardiography
        - c. CT or MRI
    - e. Collaborative management for cardiac injuries
      1. Prevention
        - a. Use treatment strategies that use lower total radiation doses and minimize cardiac exposure.
        - b. Avoid concurrent cardiotoxic chemotherapeutic agents when possible.
      2. Early detection
        - a. Perform routine cardiac evaluation during follow-up examinations.
        - b. Provide a referral to cardiology for recommendations to reduce the degree of initial cardiac injury and slow the progression of vascular, myocardial, and valvular fibrosis.
          - i. Regular EKG and echocardiograms
          - ii. Antibiotic prophylaxis for significant valve disease
          - iii. Aggressive treatment of cardiac risk factors, especially hyperlipidemia, both at the time of cardiac therapy and during follow-up
    - f. Patient and family education
      1. Importance of routine cardiac examinations
      2. Compliance with recommendations for cardiac health, including diet, maintaining an ideal weight, and exercise
      3. Signs and symptoms of heart disease to report

4. Esophageal injury
  - a. Definition (Refer to the original guideline document for details)
  - b. Pathophysiology (Refer to the original guideline document for details)
  - c. Incidence and risk factors (Refer to the original guideline document for details)
  - d. Assessment
    1. Clinical manifestations
      - a. Dysphagia
      - b. Hemoptysis with ulceration
      - c. Weight loss
      - d. Chest pain
    2. Physical examination
      - a. Weight loss
      - b. Difficulty in swallowing solid foods
    3. Additional studies: Upper endoscopy
  - e. Documentation: Nutritional alteration (Catlin-Huth, Haas, & Pollock, 2002)
    1. Anorexia
      - a. 0--None
      - b. 1--Loss of appetite
      - c. 2--Oral intake significantly decreased
      - d. 3--Requiring IV fluids
      - e. 4--Requiring feeding tube or parenteral nutrition
    2. Nausea
      - a. 0--None
      - b. 1--Able to eat
      - c. 2--Oral intake significantly decreased
      - d. 3--No significant intake, requiring IV fluids
    3. Dyspepsia and/or heartburn
      - a. 0--None
      - b. 1--Mild
      - c. 2--Moderate
      - d. 3--Severe
  - f. Collaborative management for esophageal injury
    1. Depends on the specific injury.
    2. Referral to a gastroenterologist may be appropriate for esophageal dilation, cauterization of bleeding, or placement of a stent.
  - g. Patient and family education
    1. Dietary suggestions and restrictions
    2. Signs and symptoms to report

#### E. Gastrointestinal/abdomen

1. Anorexia
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment
    1. Preexisting conditions that contribute to anorexia and weight loss are age, nicotine use, medical conditions (e.g., severe chronic obstructive pulmonary disease, diseases affecting metabolism), malignant symptoms,

and socioeconomic conditions, such as living alone and low income (Brown, 2002). Other symptoms also associated with weight loss are depression, infection, dyspnea, pain, fatigue, and the cumulative effect of several symptoms (McMahon & Brown, 2000).

2. Weight change: Compare usual weight with present weight, time interval that weight loss occurred, and weight at each visit. Weight loss of 2%-5% is considered severe (McMahon & Brown, 2000).
3. Nutritional screening tools are available, such as the Patient-Generated Subjective Global Assessment (Ottery, 1994).
4. Dietary intake: Three-day food diary, including one weekend day (Brown, 2002)
5. Functional status, such as decreased ability to care for self and maintain nutritional status, as measured by the Karnofsky Performance Status and Eastern Cooperative Oncology Group (ECOG) performance status (McMahon & Brown, 2002)
6. Physical examination findings to evaluate signs of malnutrition, such as weakness, loss of body fat, loss of muscle mass, and fluid status (McMahon & Brown, 2002)
7. Symptoms affecting nutrition, such as pain, mucositis, infection, fatigue, and depression

d. Collaborative management of anorexia

1. Acute effects

- a. Deficits in calories, protein, zinc, iron and iodine, and vitamin B<sub>12</sub> (Doerr et al., 1997; Lindsey et al., 1994)
- b. Decreased quality of life, including physical, psychological, and social functioning (Brown, 2002; Lai & Perng, 1998)
- c. Management
  - i. Nutritional counseling: Individualized or structured nutritional teaching program; regular and frequent nutritional counseling (Ovesen et al., 1993)
  - ii. Oral liquid supplement interventions (Ovesen & Allingstrup, 1992; McCarthy & Weihofen, 1999)
  - iii. Enhance calorie intake (small, frequent meals, calorie-dense foods); limit beverage intake around mealtime; take advantage of time of day when patient has best appetite.
  - iv. Supplement diet with eicosapentaenoic acid, a polyunsaturated fatty acid found in fish oil (e.g., ProSure® [Ross Laboratories]), no more than two cans per day (Ross Laboratories, 2003; Tisdale, 1996; Wigmore et al., 2000).

- v. Symptom management (nausea, vomiting, pain, constipation, depression)
  - vi. Exercise may improve physical functioning, body composition, and muscle strength (Brown, 2002).
  - vii. Goal is weight loss of less than 5% during treatment (Ottery, 1994).
- 2. Pharmacologic treatment: Progestational agents
  - a. Megestrol acetate 160-800 mg/day (Bruera et al., 1990; Fietkau, Riepl, & Kettner, 1997; Gagnon & Bruera, 1998; Kornblith et al., 1993; Loprinzi et al., 1993, 1994)
  - b. Medroxyprogesterone acetate 300-1,000 mg/day (Brown, 2002)
  - c. Potential adverse effects of progestational agents: Thromboembolic events, breakthrough bleeding, peripheral edema, hyperglycemia, hypertension, Cushing's syndrome, and alopecia (Maltoni et al., 2001)
  - d. Corticosteroids improve appetite, food intake, performance status, and quality of life. No change in body weight. Symptom management for up to four weeks (Gagnon & Bruera, 1998).
  - e. Metoclopramide 5 mg prior to meals enhances gastric motility and is useful for managing nausea and vomiting (Rust & Gill, 1997).
- e. Documentation of anorexia (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. 0--None
  - 2. 1--Loss of appetite
  - 3. 2--Oral intake significantly decreased
  - 4. 3--Requiring IV fluids
  - 5. 4--Requiring feeding tube or parenteral nutrition
- f. Patient and family education (Cunningham, 2004)
  - 1. Education on general information about nutrition: Fundamentals of good nutrition
  - 2. Sources of nutritious calories and protein
  - 3. Teach how to complete food diaries.
  - 4. Symptoms to report that affect food intake
  - 5. Patient and family participation in development and implementation of the plan for nutrition
  - 6. Related Web sites -- refer to the original guideline document
- 2. Nausea and vomiting
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment
    - 1. Risk factors

- a. Incidence and severity of past nausea and vomiting, precipitating factors
  - b. Age--More likely in patients younger than 50 years (Goodman, 1997; Morrow & Rosenthal, 1996)
  - c. Gender--More likely in menstruating women (Wickham, 2004).
  - d. Susceptibility to motion sickness (Hickock, Roscoe, & Morrow, 2001)
  - e. Unsuccessful past treatment of nausea and vomiting
  - f. Other possible causes--Concurrent chemotherapy, emetic potential of chemotherapy, other drugs (e.g., opioids), infection, constipation, intestinal obstruction, hypercalcemia, electrolyte abnormalities, and increased intracranial pressure (Wickham, 2004)
  - g. Anxiety--Patient expectation for nausea (Jacobsen et al., 1988)
2. Symptom assessment
- a. Occurrence, frequency, intensity, onset, and duration of nausea and vomiting. Use patient report such as diaries, journals, and logs (Rhodes, 1997).
  - b. Signs of dehydration (e.g., poor skin turgor, electrolyte imbalance, increased weakness or fatigue, concentrated urine, orthostatic pressure, oral cavity moisture)
  - c. Physical examination
    - i. Height and weight
    - ii. CBC: Rule out associated infection and dehydration.
    - iii. Electrolytes: Rule out dehydration--chloride and potassium due to loss in emesis (Wickham, 1999), blood urea nitrogen (BUN), creatinine ratio, carbon dioxide (CO<sub>2</sub>) (Wickham, 2004); Calcium--rule out hypercalcemia (Iwamoto, 1992).
    - iv. Oral intake over last 24-hour period
- d. Collaborative management of nausea and vomiting
- 1. Pharmacologic
    - a. 5HT<sub>3</sub> receptor antagonists block the stimulation of 5HT<sub>3</sub> receptors at various points in the body and are useful to prevent radiation-induced emesis (Bey et al., 1996; Feyer, Stewart, & Titbach, 1998; Franzen et al., 1996; Prentice et al., 1995; Roberts & Priestman, 1993; Tramer et al., 1998).
      - i. May need prophylactic prevention of constipation (Goodman, 1997).
      - ii. Headache, lightheadedness, and sedation are other common side effects.

- iii. Ondansetron, granisetron, and dolasetron have similar efficacy (Gralla et al., 1999).
  - iv. Some patients have successful control with a second 5HT3 antagonist, despite inadequate control with a first (de Wit et al., 2001; Feyer, Stewart, & Titbach, 1998).
- b. Dopamine receptor antagonists bind to D2 and other receptors to vomiting impulses.
  - i. At risk for extrapyramidal symptoms: More common in children and young adults.
  - ii. May use prophylactic diphenhydramine
  - iii. D2 receptor antagonists include phenothiazines, the most commonly used being prochlorperazine, butyrophenone, haloperidol, and substituted benzamides (metoclopramide) (Wickham, 2004).
- c. Controlled-release metoclopramide, 20-80 mg every 12 hours for a maximum period of 12 weeks, has demonstrated a 40%-60% decrease in the severity of nausea over the first two weeks of treatment and an approximate 50% reduction in severity of vomiting over the first four weeks of treatment (Wilson et al., 2002).
- d. Corticosteroids (e.g., dexamethasone, prednisone, prednisolone)--Mechanism is unclear. Possible inhibition of prostaglandin synthesis. May cause insomnia, anxiety, or euphoria (Goodman, 1997; Kirkbride et al., 2000).
- e. Benzodiazepines--Anxiolytics and amnesics may be useful for treatment of anticipatory nausea and vomiting (Malik et al., 1995).
- f. Neurokinin (NK-1) antagonists are a new class of antiemetics that block the NK-1 receptor. The NK-1 receptor antagonist is more effective in prevention of delayed emesis. When added to the best current antiemesis drug, acute emesis also was decreased. Aprepitant is approved for prevention of acute and delayed emesis with highly emetogenic chemotherapy (Hesketh et al., 1999).
- g. High risk for radiation-induced nausea and vomiting--total body irradiation (TBI) and combination therapy with emetogenic chemotherapy (Gralla et al., 1999)
  - i. 5HT3 antagonists give complete control rates of 50%-90% (Gralla et al., 1999).
  - ii. Addition of corticosteroids may be beneficial.
  - iii. Use serotonin receptor antagonist with or without corticosteroid before each fraction and for at least 24 hours afterward

- ("ASHP therapeutic guidelines," 1999; Feyer, Stewart, & Titbach, 1998; Gralla et al., 1999).
- iv. Patients receiving concurrent chemo-radiation should be given an antiemetic agent based on the level of emetogenicity of chemotherapy and risk factors associated with radiation-induced emesis (American Society of Health- System Pharmacists, 1999).
  - h. Intermediate risk for radiation-induced nausea and vomiting: Hemibody, upper abdomen, abdominal-pelvic, mantle, craniospinal-irradiation, and cranial radiosurgery
    - i. Use serotonin receptor antagonist or dopamine receptor antagonist before each fraction.
    - ii. Serotonin receptor antagonist is more effective. Efficacy may decrease after the first week.
    - iii. Dopamine receptor antagonist may be more appropriate for patient receiving craniospinal or lower half-body radiation. Dexamethasone has efficacy similar to 5HT3 antagonists for patients receiving treatment to upper abdomen (Gralla et al., 1999).
  - i. Low risk for radiation-induced nausea and vomiting: Radiation to cranium only, breast, head and neck, extremities, pelvis, thorax; treatment on as-needed basis. Use daily pretreatment dopamine antagonist, 5HT3 antagonist for rescue (Gralla et al, 1999).
2. Nonpharmacologic management
- a. Use in combination with prescribed antiemetic therapy.
  - b. May be effective by producing physiologic relaxation, which may decrease nausea and vomiting, serve as distractions, and enhance control.
    - i. Self-hypnosis: State of altered consciousness and total body relaxation to an idea (King, 1997)
    - ii. Biofeedback (King, 1997)
    - iii. Progressive contraction and relaxation of various muscle groups (King, 1997)
    - iv. Imagery: Mentally take self away by focusing on images of a relaxing place (Troesch et al., 1993).
    - v. Distraction: Learn to divert attention. Use videos, games, or puzzles (Vasterling, Jenkins, & Tope, 1993).
  - e. Documentation (Catlin-Huth, Haas, & Pollock, 2002)

1. Nausea
  - a. 0--None
  - b. 1--Able to eat
  - c. 2--Oral intake significantly decreased
  - d. 3--No significant intake, requiring IV fluids
2. Vomiting
  - a. 0--None
  - b. 1--One episode in 24 hours over pretreatment
  - c. 2--Two to five episodes in 24 hours over pretreatment
  - d. 3--More than or equal to six episodes in 24 hours over pretreatment or need for IV fluids
  - e. 4--Requiring parenteral nutrition or physiologic consequences requiring intensive care; hemodynamic collapse
- f. Patient and family education
  1. Teach patients at high or intermediate risk to self-administer antiemetics pretreatment on a daily basis.
  2. Instruct the patient to record nausea and vomiting in a diary.
  3. If the patient is vomiting, the patient should check weight daily.
  4. Teach symptoms of dehydration, such as excessive thirst, dizziness, palpitations, and fever.
  5. Practice dietary modifications such as small, frequent meals, foods that are cold or at room temperature, avoidance of favorite foods to avoid food aversions, and avoidance of fatty, spicy, salty, and sweet foods that may aggravate nausea (Wickham, 1999)
  6. Meal preparation when not feeling nauseous; share cooking with family members.
  7. Instruct nonpharmacologic methods to alleviate nausea.
  8. Use self-care guidelines for nausea and vomiting from RT (Wickham, 2004)
  9. Related Web sites (Refer to the original guideline document for details)
3. Diarrhea/proctitis
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence and risk factors (Refer to the original guideline document for details)
  - c. Assessment
    1. Individual risk factors
      - a. Prior abdominal surgery
      - b. History of pelvic inflammatory disease or colitis
      - c. History of cardiovascular disease, hypertension, or diabetes (Frankel-Kelvin, 1997)
    2. Usual pattern of elimination
    3. Change in bowel pattern: Onset, frequency, amount and character of stools, blood in stool (Cancer.gov, "Gastrointestinal complications," "Radiation enteritis," 2003)

4. Presence of other symptoms such as flatus, cramping, nausea, and abdominal distension (Cancer.gov, "Gastrointestinal complications," "Radiation enteritis," 2003)
  5. Nutritional status: Weight and height, change in eating habits, amount of residue in diet (Cancer.gov, "Gastrointestinal complications," "Radiation enteritis," 2003)
  6. Signs of dehydration: Poor skin turgor for age, serum electrolyte imbalance, increased weakness, orthostatic hypotension, and weight loss (Hogan, 1998)
  7. Level of stress, coping patterns, impact of symptoms on usual lifestyle (Hogan, 1998)
  8. Inflamed hemorrhoids
  9. Elevated temperature
  10. Comorbid conditions can exaggerate side effects (diabetes, lactose intolerance, baseline chronic GI abnormalities) (Engelking, 2004; Hogan, 1998).
  11. Assess for over-the-counter medications, as some can exacerbate diarrhea.
- d. Collaborative management of acute and chronic diarrhea
1. Dietary modification
    - a. Include low-residue foods such as baked, broiled, or steamed meat, fish, and poultry; refined grains; cooked vegetables; canned fruit and applesauce; bananas; juices and nectars (McCallum & Polisena, 2000).
    - b. Include potassium-rich foods (Hogan, 1998).
    - c. Avoid fried and fatty foods, lactose products, foods high in fiber, strong spices and herbs, caffeine, alcohol, and tobacco.
    - d. Avoid foods that are too hot or cold (Hogan, 1998). Evaluate on a case-by-case basis (Engelking, 2004).
  2. Drink 3,000 cc of fluid a day (Hogan, 1998). Some fluids should contain some salt and sugar, such as clear broth, gelatin desserts, and sports drinks or soft drinks with some carbonation removed (Saltz, 2003).
  3. Pharmacologic management: Goals are inhibition of intestinal motility, reduction in intestinal secretions, and promotion of absorption.
    - a. Bulk-forming agents--Methylcellulose and pectin, which absorb water and enhance stool bulk (may cause abdominal discomfort and bloating in some people) (Engelking, 2004; Hogan, 1998)
    - b. Loperamide hydrochloride (HCL) slows GI peristalsis, which increases GI transit time and promotes water reabsorption. Start with 4 mg at the first episode of diarrhea, followed by 2 mg after each unformed stool, with a maximum of 12-16 mg in 24 hours (Wilkes, Ingwersen, & Barton-Burke, 2002).

- c. Diphenoxylate/atropine slows GI transit time. Appears to have similar efficacy to loperamide in mild to moderate diarrhea (Saltz, 2003). It is associated with more CNS side effects, including dizziness, nausea, vomiting, and blurred vision (Engelking, 2004). Dose is one to two tablets every four hours as needed, not to exceed eight tablets in 24 hours (Cancer.gov, "Gastrointestinal complications," 2003).
- d. Paregoric may be used alternating with loperamide. Usual dose: 1 teaspoon qid as needed (Cancer.gov, "Gastrointestinal complications," 2003).
- e. Cholestyramine is a bile salt sequestering agent. Dose is one package after each meal and at bedtime (Cancer.gov, "Gastrointestinal complications," 2003; Cascinu, 1995; Frankel-Kelvin, 1997).
- f. Donnatal, an anticholinergic/antispasmodic agent, is used to alleviate bowel cramping. Dose is one to two tablets every four hours as needed (Cancer.gov, "Gastrointestinal complications," 2003).
- g. Mucosal prostaglandin inhibitors, such as aspirin or sulfasalazine, may be useful for radiation-induced diarrhea (Cancer.gov, "Gastrointestinal complications," 2003; Coia, Myerson, & Tepper, 1995; Kilic et al., 2000).
- h. Steroid foam given rectally for proctitis
- i. Narcotics may be needed for relief of abdominal pain.
- j. Prior to beginning radiation to the pelvis, barium studies should be done to determine the extent of small bowel descent within the pelvis.
- e. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. Diarrhea (patients without colostomy)
    - a. 0--None
    - b. 1--Increase of less than four stools/day over pretreatment
    - c. 2--Increase of four to six stools/day or nocturnal stools
    - d. 3--Increase of seven or more stools/day or incontinence; need for parenteral support for dehydration
    - e. 4--Physiologic consequences requiring intensive care or hemodynamic collapse
  - 2. Diarrhea (patient with colostomy)
    - a. 0--None
    - b. 1--Mild increase in loose, watery colostomy output compared with pretreatment
    - c. 2--Moderate increase in loose, watery colostomy output compared with pretreatment but not interfering with normal activity

- d. 3--Severe increase in loose, watery colostomy output compared with pretreatment, interfering with normal activity
- e. 4--Physiologic consequences requiring intensive care or hemodynamic collapse
- f. Patient and family education - refer to the original guideline document for details

#### F. Bladder

1. RT is used as part of multimodality therapy for invasive bladder cancer in combination with surgery and chemotherapy. It is therefore important for the nurse to understand the role and side effects associated with combined modality therapy (Bruner & Horwitz, 2001; Martin, 2001).
  - a. Bacillus Calmette-Guérin (BCG) is the most effective intravesical treatment for superficial bladder cancer. However, 30%-40% of tumors are refractory (Punnen, Chin, & Jewett, 2003).
  - b. Bacillus Calmette-Guérin failure is usually an indication for cystectomy, but several salvage intravesical strategies have been proposed, including combination RT (National Comprehensive Cancer Network, 2004).
  - c. Chemotherapy has been used extensively in metastatic cancer of the bladder and urinary tract (Raghavan, 2003).
    1. Transitional cell carcinomas are the tumors most responsive to chemotherapy (Raghavan, 2003).
    2. Standard single agents (e.g., methotrexate, doxorubicin, mitomycin, ifosfamide, vinblastine, cisplatin) have produced objective response rates of 15%-25%, and combination chemotherapy (e.g., taxanes, gemcitabine) has resulted in a regression in 40%-75% of cases (Raghavan, 2003).
  - d. A recent meta-analysis (Widmark et al., 2003) reported the evidence for use of RT in treatment of bladder cancer.
    1. Moderate evidence shows that hyperfractionated RT provides a survival benefit at 5 and 10 years and an increased local control rate compared with conventional fractionation.
    2. Some evidence shows that preoperative RT followed by cystectomy does not provide any significant survival benefit compared to cystectomy alone.
    3. Moderate evidence shows that palliative RT of invasive bladder carcinoma can rapidly provide tumor-related symptom relief.
    4. Moderate evidence shows that palliative hypofractionated RT, 3 fractions in 1 week, gives the same relief of symptoms as 10 fractions in 2 weeks.
    5. Conclusive information on use of RT, optimal doses, and combination therapy for bladder cancer is lacking, and large randomized trials are needed.

2. Irritative bladder symptoms (IBS)
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment: Includes urologic voiding pattern related to frequency of urination, urgency, nocturia, dysuria, and time of day it is better or worse. If symptoms are moderate to severe, have patient keep bladder diary (Berry, 2004).
  - d. Collaborative management of IBS
    1. Acute effects
      - a. Encourage patient to increase fluid intake to 2-3 liters (unless contraindicated for cardiac or other medical reasons) to keep urine more diluted, which is less irritating to the bladder mucosa and helps to wash out clots that can cause an obstruction of urine flow (Kelly & Miaskowski, 1996).
      - b. Encourage patient to avoid caffeine and spicy drinks and food because they can be irritative to the bladder mucosa (Kelly & Miaskowski, 1996).
      - c. Administer pharmacologic agents as prescribed to relieve symptoms (Berry, 2004).
        - i. Phenazopyridine hydrochloride has analgesic and anesthetic effects on the urinary tract. Useful for irritative effects of RT. Warn the patient that this drug will color the urine orange.
        - ii. Urimax® (Integrity Pharmaceuticals, Indianapolis, IN) (contains hyoscyamine sulfate) is indicated for treatment of irritative voiding and pain of the urinary tract.
        - iii. Flavoxate hydrochloride is an antispasmodic for urgency, frequency, nocturia, suprapubic pain, and incontinence associated with cystitis.
    2. Long-term effects
      - a. Long-term effects that can occur years after initial therapy include contracted bladder, ulcer formation, fistulas, and bladder dysfunction (mainly IBS) (Muruve, 2001).
      - b. For persistent symptoms of slight to moderate IBS, continue to have patient obtain prescriptions for medications.
      - c. For symptoms that cause severe IBS, refer patient to urologist for possible surgical intervention.
      - d. For suspected ulcer of fistula, refer patient to urologist for possible surgical intervention.
3. Urinary tract infection (UTI)
  - a. Pathophysiology (Refer to the original guideline document for details)

- b. Incidence (Refer to the original guideline document for details)
  - c. Assessment (Kelly & Miaskowski, 1996)
    - 1. Obtain urinalysis, with microscopic analysis and culture and sensitivity if indicated for symptom. Check urine for color, clarity, and odor.
    - 2. Check temperature.
    - 3. Check patient for diaphoresis or chills.
    - 4. Assess patient for lower abdominal or flank pain.
    - 5. Obtain a CBC to rule out an elevated white blood count, which may indicate an infection.
  - d. Collaborative management of urinary tract infection
    - 1. Administer antibiotic for urinary tract infection as directed by the urine culture and sensitivity, such as sulfamethoxazole/trimethoprim, ciprofloxacin, or nitrofurantoin (Berry, 2004).
    - 2. Monitor patient for signs and symptoms of allergic reaction from the antibiotic.
    - 3. Patient may need to be admitted to the hospital for IV antibiotic therapy if oral antibiotics do not relieve infection.
4. Hemorrhagic cystitis with irritative or hemorrhagic symptoms
- a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment (Kelly & Miaskowski, 1996)
    - 1. Monitor for signs of bleeding (e.g., patient complaining of dizziness or lightheadedness, decrease in blood pressure, weak pulse, fatigue).
    - 2. Monitor for signs of fluid volume loss (e.g., poor skin turgor).
    - 3. Monitor presence of blood in the urine. Obtain a urinalysis with microscopic analysis; observe for color, clarity, and odor.
    - 4. Monitor for anemia. Obtain a CBC; check if hemoglobin and hematocrit are within normal limits.
    - 5. Monitor patient's intake and output (Lind, 1998).
    - 6. Obtain physician order for prothrombin time and international normalized ratio to assess bleeding tendencies.
    - 7. Check frequency of urination; clots may obstruct urinary flow. Patient should void every two hours.
    - 8. Obtain order for a type and crossmatch for blood transfusion as needed.
  - d. Collaborative management
    - 1. Acute effects
      - a. If patient is unable to void, may need to obtain order to catheterize patient. Patient may need bladder irrigations with saline performed by a physician.
      - b. Obtain order for blood transfusion (packed red cells) if hemoglobin and hematocrit are low.

- c. Conjugated estrogens have been shown to normalize the prolonged bleeding time found in patients with hemorrhagic cystitis, which improves homeostasis (Liu et al., 1990).
  - d. Pentoxifylline, which is useful in providing relief from radiation fibrosis, enhances blood flow, enhancing oxygenation of the tissue. Normal dose is 400 mg three times a day (tid) orally (po) for six weeks (Muruve, 2001).
  - e. Pentosan polysulfate sodium is useful in treating the pain or discomfort of interstitial cystitis. Normal dose is 100 mg tid po. Alert the patient that this drug is a weak anticoagulant; contraindicated in patients on anticoagulant therapy (Physician's Desk Reference, 2003).
  - f. Flavoxate hydrochloride is an antispasmodic for urgency, frequency, nocturia, suprapubic pain, and incontinence associated with cystitis.
  - g. If patient is concurrently receiving chemotherapeutic agents that can cause hemorrhagic cystitis, administer sodium-2-mercaptoethane sulfonate for the prevention of hemorrhagic cystitis. The compound is given to detoxify acrolein, the byproduct of cyclophosphamide, which causes the hemorrhagic cystitis (Liu et al., 1990; Marks et al. 1995).
- 2. Long-term effects
  - a. Hyperbaric oxygen--The breathing of 100% oxygen is thought to increase vascular density, which stimulates angiogenesis leading to the repair of tissue damaged from radiation (Corman et al., 2003).
  - b. Alum can be instilled intravesically for the treatment of hemorrhagic cystitis. Alum controls the hemorrhage by causing protein precipitation in the interstitial spaces and cell membranes, which leads to contraction of bleeding vessels (Goswami et al., 1993).
- 5. Obstructive symptoms (Muruve, 2001)
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence of severe obstructive complications has been reported at 9% (Sengelov & von der Masse, 1999). (Refer to the original guideline document for details)
  - c. Assessment
    - 1. Pain, discomfort
    - 2. Decrease in bladder capacity
    - 3. Change in caliber or flow of urine, such as weak stream
    - 4. Loss of control of urine
    - 5. Inability to void
    - 6. Draw blood for electrolytes, blood urea nitrogen, and creatinine to assess renal function.

- d. Collaborative management
    - 1. Acute effects
      - a. Oxybutynin chloride is an antispasmodic indicated for neurogenic bladder problems such as retention, urinary overflow, incontinence, nocturia, urinary frequency, or urgency.
      - b. Tamsulosin hydrochloride
      - c. Antihypertensives are useful for obstructive urinary symptoms because they help to relax the smooth muscles in the body that may help improve urinary flow. Additional antihypertensive medications should not be prescribed if patient is taking one (Spratto & Woods, 2003).
        - i. Terazosin hydrochloride
        - ii. Doxazosin mesylate
    - 2. Long-term effects
      - a. For obstructive urinary symptoms unrelieved with medications, patient may need to have an indwelling catheter placed or be taught to self-catheterize.
      - b. Obstructive urinary symptoms unrelieved with oral pharmacologic management may require cystectomy.
6. Assessment: Other diagnostic tests that may be useful in determining extent of radiation side effects (Muruve, 2001)
- a. IV pyelogram is useful in evaluating anatomic abnormalities such as strictures, fistula formation, and renal calcifications in the genitourinary tract.
  - b. A computerized axial tomography scan can be useful in diagnosing bladder fistulas, bladder wall thickening, viewing the bladder intravesically with air or contrast, or detecting extraluminal masses.
  - c. Urodynamics may be helpful in assessing bladder volume, flow rate, decreased bladder compliance, and post-void residual urine caused by injury to the innervation of the bladder.
  - d. Cystoscopy may be useful in confirming acute radiation changes seen in the bladder mucosa, such as telangiectasia, diffuse erythema, increase in submucosal vascularity, and mucosal edema (Muruve, 2001).
7. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
- a. Urinary frequency/urgency
    - 1. 0--Normal
    - 2. 1--Increase in frequency or nocturia up to twice as normal
    - 3. 2--Increase > twice as normal but < hourly
    - 4. 3--Hourly or more with urgency, requiring catheter
  - b. Dysuria
    - 1. 0--None
    - 2. 1--Mild symptoms requiring no intervention
    - 3. 2--Symptoms relieved with therapy

4. 3--Symptoms not relieved despite therapy
- c. Urinary retention
  1. 0--Absent
  2. 1--Present
- d. Urinary incontinence
  1. 0--Absent
  2. 1--Present
- e. Skin sensation
  1. 0--No problem
  2. 1--Pruritus
  3. 2--Burning
  4. 3--Painful
- f. Mucous membrane alteration
  1. Drainage
    - a. 0--Absent
    - b. 1--Present
  2. Drainage odor
    - a. 0--Absent
    - b. 1--Present
8. Patient and family education (Refer to the original guideline document for details)
9. Related Web sites (Refer to the original guideline document for details)

G. Male pelvis/prostate

1. Urinary dysfunction (frequency, urgency, retention, dysuria, nocturia)
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment
    1. Presence of urinary urgency, frequency, dysuria, hematuria, and nocturia
    2. Examination of distended bladder (retention)
    3. Reports of weakened urinary stream, obstructive symptoms, urge or stress incontinence
    4. Elevated temperature
    5. Discolored or cloudy urine
    6. Bladder spasms
    7. Physical examination
      - a. Palpate and percuss abdomen and suprapubic area to assess for bladder distention or tenderness.
      - b. Allow symptoms (fever, pain, cloudy urine, or hematuria) to indicate what testing should be performed (e.g., a urinalysis and/or urine culture to detect the presence of bacteria and red and white blood cells).
  - d. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
    1. Urinary frequency/urgency
      - a. 0--Normal

- b. 1--Increase in frequency or nocturia up to two times greater than normal
    - c. 2--Increase greater than two times normal but less than hourly
    - d. 3--Hourly or more with urgency, requiring catheter
  - 2. Urinary incontinence
    - a. 0--Absent
    - b. 1--Present
  - 3. Urinary retention
    - a. 0--Absent
    - b. 1--Present
  - 4. Dysuria
    - a. 0--None
    - b. 1--Mild symptoms requiring no intervention
    - c. 2--Symptoms relieved with therapy
    - d. 3--Symptoms not relieved despite therapy
- e. Collaborative management
  - 1. Acute effects of urinary symptoms
    - a. Maintain hydration (one to two liters) throughout daytime (Iwamoto & Maher, 2001) while decreasing fluid intake in the evening to reduce the incidence of nocturia (Bruner et al., 1998).
    - b. Avoid caffeinated products. Although studies are not available specific to postradiation in patients with prostate cancer, some evidence suggests eliminating caffeine may assist in decreasing bothersome urinary symptoms (Abel et al., 1999; Albertsen, 1997; Gray, 2001).
    - c. Administer appropriate medication as prescribed.
      - i. Ibuprofen--400-800 mg three to four times daily, relieves pain by inhibiting prostaglandin synthesis (Deglin & Vallerand, 2003)
      - ii. Oxybutynin chloride--5 mg two to three times daily, not to exceed 5 mg daily or 10-15 mg daily as extra large tablets. Inhibits the action of acetylcholine and has antispasmodic action on smooth muscle. Inform patients this medication may cause drowsiness or blurred vision (Deglin & Vallerand, 2003).
      - iii. Phenazopyridine--200 mg up to three times daily, acts on urinary mucosa to produce an analgesic effect. Caution patients that urine will turn a reddish/orange color (Deglin & Vallerand, 2003; Iwamoto & Maher, 2001).
      - iv. Tamsulosin hydrochloride--0.4 mg once daily, can be increased to 0.8 mg daily if ineffective. Decreases contractions of smooth muscle within the prostatic

capsule by binding to alpha-1 receptors (Deglin & Vallerand, 2003; Prosnitz et al., 1999).

- v. Terazosin hydrochloride--1 mg or may be increased to 5-10 mg daily. Decreases contractions of smooth muscle within prostatic capsule by binding to alpha-1 receptors (Deglin & Vallerand, 2003). This drug was found to be effective in treating benign prostatic obstruction (Wilt, Howe, & MacDonald, 2002), although some controversy exists whether it is more effective than other alpha blockers (Kaplan, 2002).
- vi. Doxazosin mesylate--1 to 8 mg daily with gradual dose escalation. Decreases contractions of smooth muscle within prostatic capsule by binding to alpha-1 receptors (Deglin & Vallerand, 2003).

d. Temporary suspension of RT may be considered.

2. Long-term effects of urinary symptoms

- a. Late effects generally are managed by long-term administration of urinary analgesics, antispasmodics, or alpha-1 receptor-blocking agents mentioned under acute effects.
- b. If long-term effects are a result of decreased bladder capacity or urethral strictures, surgical or endoscopic evaluation at intervention may be necessary (Maher, 1997).

f. Patient and family education (Refer to the original guideline document for details)

2. Proctitis/diarrhea

- a. Pathophysiology: (See section V, E--Gastrointestinal/Abdomen in the original guideline document for full details)
- b. Incidence of lower GI side effects (Refer to the original guideline document for details)
- c. Assessment of symptoms (See section V, E--Gastrointestinal/Abdomen above and in the original guideline document for details)
- d. Documentation
  - 1. Elimination alteration (Catlin-Huth, Haas, & Pollock, 2002)
    - a. Diarrhea (patients without colostomy) (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
    - b. Diarrhea (patients with colostomy) (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
    - c. Proctitis (RTOG Morbidity Grading Scale)
      - i. 0--None

- ii. 1--Increased stool frequency and occasional blood-streaked stools or rectal discomfort (including hemorrhoids) not requiring medication
      - iii. 2--Increased stool frequency, bleeding, mucous discharge, or rectal discomfort requiring medication; anal fissure
      - iv. 3--Symptoms not relieved despite therapy. Increased stool frequency/diarrhea requiring parenteral support; rectal bleeding requiring transfusion; or persistent mucous discharge necessitating sanitary pads
      - v. 4--Perforation, bleeding, necrosis, or other life-threatening complication requiring surgical intervention (e.g., colostomy)
    - d. Other factors
      - i. Daily weight
      - ii. Compliance with dietary recommendations and fluid intake
      - iii. May be helpful to use a daily documentation of dietary intake and bowel pattern sheet
  - 2. Skin sensation (see section IV, C--Skin Reactions above and in the original guideline document)
- e. Collaborative management
- 1. Acute effects of diarrhea (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
    - a. Dietary management: Goal is to minimize diarrhea and abdominal cramping and initiate dietary interventions at start of treatment (Kelvin, 1997).
      - i. Low fiber to decrease irritation of mucosa and GI motility
      - ii. Low lactose to handle lactase deficiency
      - iii. Low fat, to prolong transit time
      - iv. May consider adding psyllium as a bulk-forming agent (Bliss et al., 2001; Murphy et al., 2000)
      - v. If severe diarrhea continues, eliminate any fruits and vegetables, except for bananas and applesauce.
        - If symptom still continues, treatment break may be required.
        - Consult a dietitian.
    - b. Fluid and nutrient balance: Goal is adequate amounts of fluid and nutrients to prevent dehydration, electrolyte imbalance, and weight loss.
      - i. Clear juices, broth, and decaffeinated tea
      - ii. Juices high in electrolytes (e.g., Gatorade®)

- iii. Lactose-free liquid supplements
- c. Skin alteration from diarrhea (see sections IV, C--Skin Reactions; V, E--Gastrointestinal/Abdomen above and in the original guideline document)
  - i. If appropriate, suggest the use of sanitary pads or adult incontinence briefs for rectal discharge or stool incontinence.
  - ii. Aggressive personal and anal hygiene (Boyd & Berardi, 2002)
- d. Medications/pharmacologic: After three or more watery bowel movements a day, initiation should begin (Kelvin, 1997).
  - i. Initial treatment: Anticholinergic medications (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
  - ii. If experiencing proctitis, consider administering appropriate medication as prescribed.
    - Hydrocortisone preparations (creams, ointments, suppository, or foam) can be used up to four times daily (Boyd & Berardi, 2002; Donjon & Goeckner, 1999).
    - Topical lidocaine--Apply as needed, not to exceed 30 g per day
    - Aluminum acetate--Powder or tablets dissolved in tepid water and soaks applied three to four times daily for one week (Donjon & Goeckner, 1999). May be used with sitz baths.
    - Sucralfate--1 g qid or 2 g bid by mouth (Deglin & Vallerand, 2003; Sasai et al., 1998). May also be used in an enema preparation (Melko et al., 1999)
    - Mesalamine--Rectal suppository or suspension enema one bottle per rectum at night; however, this may cause diarrhea (Deglin & Vallerand, 2003; Goldstein & DiMarino, 2000).
- iii. If no response to pharmacologic interventions
  - Consult proctologist/gastroenterologist if diarrhea or rectal bleeding is unresolved by pharmacologic interventions.
  - Send stool for *Clostridium difficile* toxin if early into treatment or not responding to pharmaceuticals (can be caused by chemotherapy,

RT, prolonged hospitalization, and high doses of antibiotics) (Blot et al., 2003).

- Treatment breaks may be considered during therapy.

2. Long-term effects of diarrhea

- a. Maintain low-fiber diet (Iwamoto & Maher, 2001).
- b. Maintain aggressive anal/personal hygiene (Boyd & Berardi, 2002).
- c. Continue the use of sanitary pads or adult incontinence briefs as needed.
- d. Long-term use of medications for both urinary morbidity as described above and antidiarrheal/proctitis medications also as described above with the possible addition of the following.
  - i. Hydrocortisone enemas (Gul et al., 2002)
  - ii. Sucralfate enemas (Gul et al., 2002)
- e. Close follow-up with proctologist/gastroenterologist if indicated who may recommend the following.
  - i. Laser treatment to cauterize bleeding vessels within the rectum (Kaassis et al., 2000; Taieb et al., 2001)
  - ii. Formalin instillation or applied topically for chronic hemorrhagic proctitis (Counter, Froese, & Hart, 1999; Luna-Perez & Rodriguez-Ramirez, 2002; Ouwendijk et al., 2002).
  - iii. Hyperbaric oxygen treatments (Warren et al., 1997).
- f. Patient and family education (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)

3. Sexual dysfunction (see section IV, F--Sexual Dysfunction above and in the original guideline document)

- a. Pathophysiology (Refer to the original guideline document for details)
- b. Incidence (Refer to the original guideline document for details)
- c. Assessment (Bruner et al., 1998; Maher, 1997; Teloken, 2001)
  1. Baseline dysfunction prior to initiation of treatment
  2. Baseline sexual activity level
  3. Baseline satisfaction/dissatisfaction with intercourse
  4. Medications or comorbid conditions (hypertension, diabetes, peripheral vascular disease, neuropathy)
  5. Decreased ability to achieve erection
  6. Decreased sensation during intercourse
  7. Retrograde ejaculation
  8. Decreased ability to achieve orgasm
- d. Documentation (in addition to baseline and existing symptoms) (see section IV, F--Sexual Dysfunction above and in the original guideline document)

- e. Collaborative management
  - 1. Acute effects of sexual dysfunction (see section IV, F--Sexual Dysfunction above and in the original guideline document) (Bruner et al., 1998; Teloken, 2001)
    - a. Factors such as stress and impaired coping may contribute to acute onset of impotence.
    - b. Interventions for acute onset of impotence would not significantly differ from those carried out under long-term effects (refer to interventions below).
  - 2. Long-term effects of sexual dysfunction (see section IV, F--Sexual Dysfunction in the original guideline document) (Bruner et al., 1998)
    - a. Patient and spouse may need to be referred for professional counseling regarding the physical and psychological effects of sexual dysfunction.
    - b. Referral to urology for other alternative treatments
      - i. Other nonsurgical approaches include urethral suppositories, intracavernous injections, and vacuum devices.
      - ii. Penile prostheses have yielded satisfaction rates of up to 85% (Mulcahy, 2000).
- f. Patient and family education (Refer to the original guideline document for details)

#### H. Female pelvis

- 1. Introduction (Refer to the original guideline document for details)
- 2. Skin changes
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Staging/assessment of symptoms
    - 1. Risk factors
      - a. Skin folds in perineum within the treatment field
      - b. Concomitant use of chemotherapy/radiosensitizing agents before, during, or after radiation
      - c. Autoimmune diseases or other comorbid conditions
      - d. Medications: Steroids
    - 2. Clinical manifestations
      - a. Pruritus
      - b. Pain
  - 3. Physical examination (see section IV, C--Skin Reactions above and in the original guideline document)
  - 4. Documentation (see sections IV, B--Fatigue; IV, C--Skin Reactions; and IV, D--Pain above and in the original guideline document)

- a. Use assessment tools developed (Catlin-Huth, Haas, & Pollock, 2002).
    - b. In addition, document any changes in vaginal discharge (i.e., amount, color, odor).
  - d. Collaborative management
    - 1. Acute effects (see section IV, C--Skin Reactions above and in the original guideline document)
    - 2. Late effects (see section IV, C--Skin Reactions above and in the original guideline document)
  - e. Patient and family education
    - 1. Perform nutritional evaluation and education to ensure proper diet to enhance tissue healing.
    - 2. Instruct on signs and symptoms of infection, enforce need to report them (e.g., fever, chills, drainage, odor).
    - 3. Instruct on use of pain medications and antipruritic medications.
    - 4. Minimize friction: Wash area with hands, not with a washcloth; pat area dry with a soft, clean towel or blow dry with hair dryer on cool setting; wear loose-fitting, soft clothing (preferably cotton because it is absorbent and allows evaporation of moisture).
    - 5. Avoid scratching.
    - 6. Avoid rubbing vigorously and massaging.
    - 7. Avoid use of tape in area.
    - 8. Avoid extreme temperatures (e.g., heating pads, ice packs).
    - 9. Avoid irritants (e.g., soaps, perfumes, powders [other than those recommended by the physician or nurse]).
      - a. Wash skin with mild soap and lukewarm water.
      - b. Keep skin folds dry.
- 3. Urinary frequency/dysuria
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment of symptoms
    - 1. Clinical
      - a. Symptoms indicative of bladder irritation (i.e., changes from baseline, including urinary frequency, dysuria, urgency, nocturia, and hematuria)
      - b. Urge incontinence (occurs at the time of sensation of bladder fullness associated with the immediate desire to urinate)
      - c. Stress incontinence associated with activity
      - d. Obstructive symptoms (e.g., decrease in flow, force of flow)
    - 2. Physical examination

- a. Palpate and percuss abdomen and suprapubic area to assess for bladder distention or tenderness.
  - b. As indicated by symptoms, conduct a urinalysis and/or urine culture (fever, pain, cloudy urine, or hematuria) to detect the presence of bacteria and red and white cells.
- d. Documentation: Elimination alteration (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. Urinary frequency/urgency
    - a. 0--Normal
    - b. 1--Increase in frequency or nocturia up to two times the normal
    - c. 2--Increase more than two times the normal but less than hourly
    - d. 3--Hourly or more with urgency, requiring catheter
  - 2. Urinary incontinence
    - a. 0--Absent
    - b. 1--Present
  - 3. Urinary retention
    - a. 0--Absent
    - b. 1--Present
  - 4. Dysuria
    - a. 0--None
    - b. 1--Mild symptoms requiring no intervention
    - c. 2--Symptoms relieved with therapy
    - d. 3--Symptoms not relieved despite therapy
  - 5. Drainage: Fistula recto-vaginal
    - a. 0--Absent
    - b. 1--Present
  - 6. Type of drainage
    - a. Fecal
    - b. Urinary
- e. Collaborative management
  - 1. Acute effects of urinary frequency/dysuria: Interventions for acute effects of urinary symptoms
    - a. Instruct patient to drink one to three liters of fluids per day while decreasing fluid intake in the evening to reduce the incidence of nocturia (Bruner et al., 1998).
    - b. Encourage patient to avoid caffeine products (e.g., coffee, tea, cola), alcohol, spices, chocolate, and tobacco products (Dow et al., 1997)
    - c. Send urine specimen for urinalysis and cultures to rule out infectious process that may be contributing to symptoms.
    - d. Administer appropriate medication as prescribed.
      - i. Ibuprofen--400-800 mg three to four times daily, relieves pain by inhibiting prostaglandin synthesis (Deglin & Vallerand, 2003)

- ii. Use of antispasmodics--Provide relief from symptoms of dysuria
      - Phenazopyridine hydrochloride
      - A combination of antiseptic and parasympatholytics
    - iii. Use of antispasmodics--Provide relief from bladder spasms (relax the bladder smooth muscle by inhibiting the muscarinic effect of acetylcholine)
      - Oxybutynin chloride
      - Flavoxate hydrochloride
      - Tamsulosin hydrochloride--0.4 mg once daily, can be increased to 0.8 mg daily if ineffective. Decreases contractions of smooth muscle within the prostatic capsule by binding to alpha-1 receptors (Deglin & Vallerand, 2003).
  - e. Use of antihypertensive medication (Relaxation of smooth muscle can be produced by blockade of alpha-1 adrenergic adrenoreceptors in the bladder.)
    - i. Terazosin hydrochloride
    - ii. Doxazosin mesylate--use with caution in patients on hypertensive medication.
    - iii. Treatment break may be considered.
- 2. Long-term effects of urinary frequency/dysuria
  - a. A long-term complication of vesicovaginal fistula usually requires a urinary diversion until the fistula heals.
    - i. Requires multidisciplinary approach including surgery
    - ii. May require TPN to reduce bowel content and provide adequate calories to promote healing
    - iii. Hyperbaric oxygen therapy may be necessary (Williams et al., 1992).
  - b. Radiation fibrosis causing the formation of urethral strictures may require the placement of urethral stents.
- f. Patient and family education
  - 1. Inform patient and family of potential for urinary side effects from pelvic irradiation.
  - 2. Educate patient and family as to signs and symptoms of urinary tract infection and radiation-induced cystitis.
  - 3. Instruct patient and family to report first signs and/or symptoms of radiation-induced cystitis.
  - 4. Instruct patient in dietary interventions and promote adequate hydration.
  - 5. Reassure patient as to the availability of medications should symptoms become problematic. Thoroughly review side-effect profile and possible drug interactions with patient as appropriate.

4. Diarrhea/proctitis
  - a. Pathophysiology (see section V, E--Gastrointestinal/Abdomen in the original guideline document for full details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment of symptoms (see section V, E—Gastrointestinal/Abdomen above and in the original guideline document for full details)
  - d. Documentation
    1. Elimination alteration (Catlin-Huth, Haas, & Pollock., 2002)
      - a. Diarrhea (patient without colostomy) (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
      - b. Diarrhea (patients with colostomy) (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
      - c. Proctitis (RTOG Morbidity Grading Scale)
        - i. 0--None
        - ii. 1--Increased stool frequency, occasional blood-streaked stools, or rectal discomfort (including hemorrhoids) not requiring medication
        - iii. 2--Increased stool frequency, bleeding, mucus discharge, or rectal discomfort requiring medication; anal fissure
        - iv. 3--Increased stool frequency/diarrhea requiring parenteral support; rectal bleeding requiring transfusion; or persistent mucus discharge necessitating pads
        - v. 4--Perforation, bleeding, necrosis, or life-threatening complication requiring surgical intervention (e.g., colostomy)
      - d. Other factors
        - i. Documentation of daily weight
        - ii. Compliance with dietary recommendations and fluid intake: May be helpful to use a daily documentation of dietary intake and bowel pattern sheet
      - e. "Weekly Bowel Pattern Recording Sheet: Self-Care Guide" (Engelking, 2004).
    2. Skin sensation (see section IV, C--Skin Reactions above and in the original guideline document)
  - e. Collaborative management
    1. Acute effects of diarrhea (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
      - a. Dietary management: Minimize diarrhea and abdominal cramping, initiate dietary interventions at start of treatment.
        - i. Low fiber to decrease irritation of mucosa and GI motility
        - ii. Low lactose to handle lactase deficiency

- iii. Low fat to prolong transit time
    - iv. If severe diarrhea continues, eliminate any fruits and vegetables, except bananas and applesauce.
      - If symptom still continues, treatment break may be required.
      - Consult a dietitian (Dow et al., 1997; Nelson et al., 1994; Woodtli & VanOrt, 1991).
  - b. Fluid and nutrient balance: Adequate amounts of fluid and nutrients to prevent dehydration, electrolyte imbalance, and weight loss
    - i. Encourage clear juices, broth, decaffeinated tea, sports drinks high in electrolytes (e.g., Gatorade®), and lactose-free liquid supplements.
    - ii. IV hydration and electrolyte replacement during daily visits may be necessary (Dow et al., 1997; Hassey, 1987; Nelson et al., 1994; Sitton, 1992)
  - c. Medications/pharmacologic: After three or more days, note watery bowel movements and day of initiation.
    - i. Initial treatment is anticholinergic medications (see section V, E-- Gastrointestinal/Abdomen above and in the original guideline document).
    - ii. If not effective at full dose, opium derivatives can be used.
    - iii. Bulk laxatives absorb fluid and increase stool bulk (should be taken with less liquid than when used for constipation).
    - iv. Ongoing dietitian involvement (Dow et al., 1997)
2. Long-term effects of diarrhea
- a. Possibility of radiation-induced fistula: Most frequent major sequelae at 1.5% in patients receiving irradiation alone versus 1.6% in patients treated with irradiation plus surgery for cervical cancer (Perez et al., 1995).
    - i. Caused by two factors--Recurrent disease or radiation-induced. If recurrent disease is ruled out, treatment must be very aggressive to promote healing.
    - ii. Small bowel and rectovaginal fistulas are very painful and usually require a temporary colostomy. This allows bowel to rest and to promote healing. Once fistula has healed, colostomy can be reversed.
  - b. Small bowel obstruction
    - i. 1.8% in patients receiving irradiation alone versus 4.2% in patients treated with

- irradiation plus surgery for cervical cancer (Perez et al., 1995)
      - ii. Increased chances of obstruction with continued radiation to pelvis and abdominal surgeries
      - iii. If obstruction occurs, patient may need to be on clear liquid diet to rest bowel or may need to perform colostomy or ileostomy to relieve obstruction. May occur several years after completion of treatment.
    - c. Perforation: May develop if obstruction is not acted upon. Colostomy is necessary to rest bowel and promote healing of anastomosis of bowel after surgery. Usually temporary but dependent on site of perforation.
  - f. Patient and family education (see section V, E--Gastrointestinal/Abdomen above and in the original guideline document)
    - 1. Inform patient that diarrhea is an expected side effect of radiation to the pelvis and usually occurs after 2.5 to 3 weeks of treatment.
    - 2. Teach dietary modifications.
    - 3. Instruct patient and family in comfort measures (e.g., sitz bath, tepid water cotton cloth soaks).
    - 4. Explain protocol for perianal hygiene (mild soap, do not rub, pat dry).
    - 5. Describe signs and symptoms of dehydration.
    - 6. Instruct patient to keep a log of number and consistency of bowel movements per day.
    - 7. Inform patient and family members of medications available to alleviate treatment-related side effects. Thoroughly review side-effect profile and possible drug interactions. Instruct in appropriate use of any suppositories, foams, ointments, or enemas if prescribed.
    - 8. Post-treatment late effects: Instruct patient on reporting symptoms, including changes in stools, rectal bleeding, or pain at follow-up visits or to call physician.
  - g. Teaching tools for specific site
5. Sexual dysfunction (see section IV, F--Sexual Dysfunction above and in the original guideline document)
  - a. Pathophysiology (Refer to the original guideline document for details)
  - b. Incidence (Refer to the original guideline document for details)
  - c. Assessment of symptoms
    - 1. Risk factors
      - a. Sexual dysfunction needs to be assessed prior to start of radiation because it may lead to a greater risk for sexual problems posttherapy.

- b. Sexual activity pretreatment appears to be the best predictor of post-treatment sexual activity (Anderson, Woods, & Cryanowski, 1994).
  - c. Pre-radiation treatment surgical intervention(s)
- 2. Clinical
  - a. Sexual history: Pretreatment history of sexual activity should include sexual preference, age at first intercourse, number of sexual partners, marital relationship, and any problems with desire, arousal, or orgasm. The nurse must have an open mind and accept the couple's sexual practice (Cartwright-Alcares, 1995).
  - b. Frequency of sexual activity over past 6-12 months
  - c. Satisfaction with ability
  - d. Satisfaction with frequency
  - e. Dyspareunia
  - f. Decrease in vaginal lubrication and sensation
- 3. Physical examination
  - a. Check external genitalia and perineum for skin changes over vulva and around anus for lesions, inflammation, or skin breakdown.
  - b. Examine patient for vaginal stenosis.
  - c. Check for vaginal discharge or vaginal bleeding.
- 4. Psychological
  - a. History of sexual abuse
  - b. Body image: Radiation will cause either temporary or permanent gonadal failure as well as changes in body image (Cartwright-Alcares, 1995).
- d. Collaborative management
  - 1. Acute effects of sexual dysfunction (see section IV, F-- Sexual Dysfunction above and in the original guideline document)
    - a. Prepare the patient for the acute effects radiation treatment will cause to sexual function.
      - i. Support the patient on concerns of sexual dysfunction.
      - ii. Encourage open communication between patient and partner. The most difficult aspect of discussing sexuality with patients is getting started. A simple question such as "How are things going sexually?" may be all it takes to initiate a conversation that can be a very positive influence on the patient's postdiagnosis sexual relationship(s) (Auchincloss, 1990).
      - iii. Refer patient with history of sexual abuse or marital problems to a social worker, family counselor, or sex therapist.
    - b. Educate patient in use of pain medication prior to sexual activity to help manage symptoms (e.g., pain) prior to engaging in activity. Teach proper

- positioning for continued sexual activity to prevent discomfort, depending on therapy or problem (Bruner & Iwamoto, 1996).
  - c. Radiotherapy can cause vaginal dryness and vaginal stenosis, but these symptoms can be improved by the use of vaginal dilators and lubricants (Stead, 2003).
- 2. Long-term effects of sexual dysfunction (see section IV, F--Sexual Dysfunction above and in the original guideline document)
  - a. Vaginal stenosis: To prevent vaginal stenosis, teach women to use a vaginal dilator following intracavitary implant (Bruner & Iwamoto, 1996).
  - b. Vaginal dryness: Educate patient on the use of vaginal lubricants during sexual activity (Bruner & Iwamoto, 1996).
    - i. K-Y® Jelly (Johnson & Johnson, Fort Washington, PA)
    - ii. Astroglide® (Biofilm, Inc., Vista, CA)
    - iii. Replens® (Parke-Davis, Morris Plains, NJ)
- e. Documentation (Catlin-Huth, Haas, & Pollock, 2002)
  - 1. Sexuality alteration (see section IV, F--Sexual Dysfunction above and in the original guideline document)
  - 2. Mucous membrane alteration
    - a. Drainage
      - i. 0--Absent
      - ii. 1--Present
    - b. Drainage odor
      - i. 0--Absent
      - ii. 1--Present
    - c. Vaginal bleeding
      - i. 0--None
      - ii. 1--Spotting requiring two pads per day
      - iii. 2--Requiring  $\geq 2$  pads every day, but not requiring transfusion
      - iv. 3--Requiring transfusion
      - v. 4--Catastrophic bleeding, requiring major nonelective intervention
- f. Patient and family education (Refer to the original guideline document for details)

## Disease Specific Management

### A. Sarcoma

- 1. Introduction and overview of disease (Refer to the original guideline document for details)
- 2. Incidence and risk factors (Refer to the original guideline document for details)
- 3. Radiation treatment
  - a. Treatment is usually directed with curative intent.

- b. Management of soft tissue sarcomas (STS) of the extremity has changed dramatically from the days when amputation was the rule. Curative treatment in extremity sarcomas now emphasizes limb-sparing surgery and function-sparing radiotherapy (Alektiar et al., 2002). Use of intraoperative RT after removal of retroperitoneal sarcomas, followed by external beam radiotherapy, may improve outcomes in this difficult setting (Hu & Harrison, 2000). Head and neck sarcomas present unique challenges because of the heterogeneity of tumor types and presentations. However, surgical resection, with as wide a margin as is possible, followed by external beam RT (EBRT) is the standard of care, and concomitant chemotherapy may be used (Kraus, Harrison, & O'Malley, 1999; Sturgis & Potter, 2003).
- c. Palliative radiation is sometimes given when a sarcoma causes significant pain, loss of mobility, and diminished quality of life. However, tumoricidal doses of radiation are not usually tolerated in this setting, and the amount of radiation that can be delivered safely is ineffective more than 50% of the time. Chemotherapy is a more common palliative treatment, or in the case of extremity sarcoma, a palliative amputation may be used (Forscher & Casciato, 2000).
- d. EBRT is the primary means of delivering radiation. Sequencing of preoperative versus postoperative RT varies. Treatment outcomes (overall survival, local control) are essentially the same, but a small increase in RT-related complications after post-operative RT was noted in one recent study (Zagars & Ballo, 2003).
- e. Postoperative RT often involves radiation to a flap or graft used to close the surgical wound following resection. A recent review (Spierer et al., 2003) from one institution analyzed 43 patients who underwent limb-sparing surgery and reconstruction of the surgical defect followed by RT. Five of 43 patients developed wound complications necessitating surgery, but the majority (95%) tolerated the RT without difficulty.
- f. Low dose rate (LDR) brachytherapy can be used alone or in conjunction with EBRT following surgery. This usually involves placement of after-loading catheters into the tumor bed following surgical excision of the tumor. These catheters are later "loaded" with radioactive seeds for three to five days. The seeds and catheters then are removed, prior to the patient's discharge from the hospital. For more detail on brachytherapy, see section VII in the original guideline document. A 5-year local control rate of 84% with an overall survival rate of 70% was reported in one institution's nearly 15-year experience with brachytherapy alone following surgical excision for high-grade primary soft tissue sarcoma. Poorer outcomes were noted with shoulder locations, upper extremity sarcomas, and in cases with positive margins (Alektiar et al., 2002) (see section VII below and in the original guideline document).
- g. Intraoperative RT (IORT) uses electrons (IOERT) or high-dose rate (HDR) photons (HDR-IORT) during surgery and provides focused radiation to the bed of resected tumors, such as

retroperitoneal sarcomas (see section VII, F--Intraoperative below and in the original guideline document). This delivery method focuses intense radiation to the surgical bed or area at risk, while minimizing radiation injury to normal tissues (bowel, bladder). Following recovery from surgery, additional radiation often is given via external beam up to normal tissue tolerance. The combination of EBRT and IORT provides tumoricidal doses with acceptable morbidity (Dunne-Daly, 1997; Hu & Harrison, 2000; Mackenzie et al., 2003) (see section VII, F--Intraoperative below and in the original guideline document).

#### 4. Acute effects

- a. Acute reactions include skin reaction, pain, difficulty in coping, changes in sexuality, fatigue, nausea, diarrhea, and marrow suppression. (The assessment and management of all but marrow suppression are discussed in other sections of the original guideline document.)
- b. Marrow suppression is an acute effect of RT whenever significant bone marrow is in the field of treatment, as in extremity sarcoma. Mild neutropenia can occur but usually is self-limiting and does not require colony-stimulating support. As in any marrow suppression, patients must be given detailed neutropenia precautions. Weekly CBCs should be assessed as well (Shelton, 2003).
- c. Abdominal RT may cause nausea and/or diarrhea. Premedication with an antiemetic is important from start of treatment to minimize the development of anticipatory nausea. Dietary changes to decrease intake of fat, lactose, and fiber may be helpful, and patients should obtain an antidiarrheal to keep in the home in case diarrhea develops (Kelvin, 1997).

#### 5. Late effects

- a. Lymphedema may be present following surgery and exacerbated by RT. However, radiation-related lymphedema is more commonly seen in the weeks to months following completion of treatment. It is more likely to occur when a large area of an extremity is radiated and with longer portals, >35 cm. Efforts are made during treatment planning to spare at least 33% of the circumference of the extremity from direct radiation, minimizing risk of impaired lymph and vascular flow post-treatment (Stinson et al., 1991).
- b. Joints also are spared from direct radiation whenever possible. A retrospective review (Stinson et al., 1991) of 145 patients, performed by the Radiation Oncology branch of NCI, found that if 50% or more of a joint was irradiated, contracture was much more common. Physical therapy is encouraged throughout treatment to maximize flexibility and function of limbs.
- c. When the growth plate of an extremity or epiphysis is radiated, there is a possibility of impaired growth of that extremity with resultant deformity or dysfunction. Again, every effort is made during treatment planning to avoid direct radiation to this area, but occasionally it is necessary. In that case, a thorough

discussion during consultation is crucial to ensure patient/caregiver understanding of possible treatment sequelae. This is of particular importance when treating a still-growing child (Stinson et al., 1991).

6. Patient and family education
  - a. Assess patient/caregiver understanding of the disease process, treatment proposed, and patient/caregiver ability and readiness to learn.
  - b. Review the RT treatment procedure(s) to be used--IORT, brachytherapy, and/or EBRT.
  - c. Review the treatment schedule; give a patient calendar if undergoing several stages of treatment (i.e., IORT plus EBRT for retroperitoneal sarcoma).
  - d. Review expected acute side effects and their management. This may include skin reaction, pain, difficulty in coping, changes in sexuality, fatigue, and marrow suppression. When an extremity sarcoma is being treated, teach patients and caregivers to elevate the extremity if swelling/edema occurs.
  - e. Near completion of treatment, review follow-up care and appointment schedules with patients and caregivers. Review the possible late effects and the importance of timely follow-up care.
  - f. Document all of the above in the patient's record.
7. Follow-up management
  - a. Recurrence is seen in up to one-third of all patients treated with multimodality therapies following an 18-month disease-free interval.
  - b. Whenever possible, surgical resection is done, with or without postoperative RT. Meticulous follow-up by the radiation oncologist and surgeon is required (Graham, 2001).
    1. Perform a thorough history and complete physical at each follow-up visit, typically every three to four months the first year following treatment, extending over time to semiannually, to annually by the fifth year post-treatment. Evaluate the site of disease as well as associated nodal chains.
    2. An annual chest radiograph is standard. Any abnormalities found are evaluated by chest CT or PET scan.

## B. Lymphoma

1. Introduction and overview of disease (Refer to the original guideline document for details)
2. Incidence and risk factors (Refer to the original guideline document for details)
3. Radiation treatment
  - a. Hodgkin's disease treatment includes the involved and contiguous lymphatic chains. This encompasses the clinically apparent disease and the contiguous nodal regions at risk for subclinical disease (Hull & Mendenhall, 2001).

1. Mantle field includes all of the major lymph node regions above the diaphragm. The field extends from the inferior portion of the mandible almost to the level of the insertion of the diaphragm. Individually contoured lung block is designed to conform to the patient's anatomy and tumor distribution (Hoppe, 1998).
  2. Preauricular field is used when the primary site of enlarged nodes may include bulky high cervical nodes, extending very near the upper border of the typical mantle field (Chao, Perez, & Brady, 1999).
  3. Sub-diaphragmatic field is the inverted Y, includes para-aortic nodes and bilateral pelvic, inguinal, and femoral nodal regions (see Figure 14 in the original guideline document) (ports used for total nodal irradiation). The spleen also may be included (Hull & Mendenhall, 2001).
  4. Total lymphoid irradiation (TLI) refers to sequential treatment to a mantle and inverted Y field. When the sub-diaphragmatic field does not include the pelvis, the term used is subtotal lymphoid irradiation (Chao, Perez, & Brady, 1999) (see section VII, I--TMI below and in the original guideline document).
- b. RT for non-Hodgkin's lymphoma (NHL) is based on the location of the tumor, which defines the treatment volume, critical organs, and dose-limiting structures (Gospondarowicz & Wasserman, 1998).
1. Involved field irradiation is most commonly used for localized lymphomas and implies treatment to the involved nodal regions with adequate margins or to the extranodal site and its immediate lymph node drainage area (Gospondarowicz & Wasserman, 1998).
  2. Consolidative radiation after chemotherapy to areas of bulk disease
  3. Relapse treatment is individualized based on prior chemotherapy or radiation treatment.
  4. Total skin irradiation (TSI) of cutaneous T cell lymphoma (see section VII, J--Total Skin Electron Beam Therapy below and in the original guideline document).
4. Mantle field irradiation
- a. Acute effects (Lymphoma Information Network, 2000; Sitton, 1992)
    1. Fatigue
    2. Hair loss
    3. Skin reaction
      - a. Skin reactions result from the depletion of actively proliferating cells in a renewing cell population.
      - b. See section IV, C--Skin Reactions above and in the original guideline document
  4. Changes in taste

- a. The taste buds are radiosensitive, and the changes may include blunting or increased sensitivity to certain tastes. Normal taste may return months after treatment is completed.
  - b. Have the patient perform oral care prior to eating.
  - c. Add spices and seasoning to food if not treating the mantle field.
  - d. Try out different foods.
  - e. See section V, B--Head and Neck above and in the original guideline document
- 5. Mucositis (see section V, B--Head and Neck above and in the original guideline document)
- 6. Xerostomia
  - a. Xerostomia occurs when the salivary glands are treated with radiation. The saliva becomes thick and ropery. It occurs at 10 Gy and is permanent at 40 Gy (Bruce, 2004).
  - b. Frequent prophylactic dental care
  - c. Fluoride treatment
  - d. See section V, B--Head and Neck above and in the original guideline document
- 7. Dysphagia/esophagitis
  - a. It is caused by irritation of the membranes lining the throat and esophagus. Usually seen after the second or third week of treatment and may continue for months after treatment.
  - b. Eat soft, bland foods such as puddings, custards, and yogurt.
  - c. Take dietary supplements.
  - d. Avoid irritants such as citrus and alcohol.
  - e. Medicate with viscous xylocaine, liquid antacids, or narcotics.
  - f. See section V, D--Thoracic above and in the original guideline document Nausea and vomiting
  - g. Nausea and vomiting occur when neurotransmitters are stimulated and an impulse is sent to the autonomic nervous system, causing nausea, and to the somatic and visceral system to produce vomiting (Murphy-Ende, 2000).
  - h. Take antiemetic prior to treatment and as needed.
  - i. Schedule treatment at the end of the day.
  - j. Avoid eating just prior to treatment.
- 8. Decreased blood counts
  - a. Thrombocytopenia occurs from deficient production of platelets or an accelerated platelet destruction (Lynch, 2000).
  - b. Neutropenia is caused by decreased neutrophils in the body resulting in an increased risk of infection (Lynch, 2000).
  - c. Check CBC weekly during treatment and hold treatment as needed.

- b. Long-term effects
  - 1. Thyroid dysfunction
    - a. Subclinical hypothyroidism develops in approximately 50% of the patients with Hodgkin's disease (HD). It is manifested by an elevation of the thyroid-stimulating hormone (TSH), even with a normal thyroxine level (Chao, Perez, & Brady, 1999).
    - b. Thyroid profile (blood work) with follow-up visits
    - c. Thyroid hormonal replacement as needed
  - 2. Radiation pneumonitis
    - a. May develop within 6-12 weeks after completing treatment. Associated with lung inflammation that is characterized by a mild, nonproductive cough, low-grade fever, and difficult breathing with exertion. Occurs in 1% or less of patients receiving mantle field irradiation. The risk may increase if the chemotherapy drug bleomycin was used in combination with RT (Hoppe, 1998).
    - b. Fewer than 5% of patients develop symptomatic pneumonitis, manifested by cough, fever, pleuritic chest pain, and infiltrate on chest radiograph that often conforms to the irradiation fields. Symptomatic management usually is sufficient; however, a small proportion of patients require treatment with corticosteroids (Chao, Perez, & Brady, 1999).
  - 3. Cardiovascular disease
    - a. Mediastinal radiation predisposes patients to premature coronary artery disease and pericardial and myocardial fibrosis, but modification to treatment techniques have decreased the dose of radiation to the heart (Hancock, Tucker, & Hoppe, 1993).
    - b. Refer to a cardiologist if symptomatic.
  - 4. Radiation pericarditis (Hoppe, 1998)
    - a. Occurs in fewer than 5% of patients. It presents as an acute febrile syndrome with chest pain and friction rub; it usually clears within a few weeks.
    - b. Routine echocardiogram
    - c. Analgesics and NSAIDs
    - d. Refer to a cardiologist if symptomatic.
    - e. Tamponade or constrictive pericarditis is more serious. It is seen in less than 1% of patients and may require surgical correction (Hoppe, 1998).
  - 5. Infection
    - a. Herpes zoster can occur during treatment or within the first two years after treatment in 10%-15% of patients (Hoppe, 1998).
    - b. Initiate acyclovir.
  - 6. Lhermitte's sign

- a. Develops in approximately 10%-15% of patients and is caused by transient demyelination of the spinal cord.
  - b. Occurs one to two months after treatment and spontaneously resolves after two to six months (Chao, Perez, & Brady, 1999).
- 7. Secondary malignancies
  - a. The mean 15-year actuarial risk for any secondary malignant neoplasm in survivors of Hodgkin's disease or NHL is 17.6% compared with 2.6% in the general population (Fernsler & Fanuele, 1998).
  - b. The following are the most common secondary malignancies in Hodgkin's disease or NHL.
    - i. Leukemia
    - ii. Breast cancer
    - iii. Thyroid cancer (peaks 15-19 years post-radiation treatment)
    - iv. Lung cancer (great risk among those who smoked at the time of diagnosis and who continued smoking after treatment)
- 8. Para-aortic and spleen field
  - a. Acute effects
    - i. Nausea and vomiting
    - ii. Diarrhea (Lymphoma Information Network, 2000)
      - Low-residue diet
      - Antidiarrheal medication
    - iii. Decreased blood counts
    - iv. Fatigue
  - b. Long-term effects
    - i. Post-splenectomy sepsis (Chao, Perez, & Brady, 1999)
      - Can be caused by *Streptococcus pneumoniae*, *meningococcus*, and *Haemophilus* strains.
      - This can be minimized by prior immunization against these organisms.
    - ii. Preventive care (Young, Bookman, & Longo, 1990)
      - Pneumococcal vaccine every five years
      - Influenza vaccine every year
      - Prompt treatment of febrile disease
- 9. Pelvic node fields
  - a. Acute effects
    - i. Diarrhea
    - ii. Decreased blood counts
    - iii. Fatigue
  - b. Long-term effects (Sitton, 1992)
    - i. Sterility in males

- Sperm production may be reduced or stopped during therapy. It may return to normal in three to five years. Sterility may be permanent if the patient received alkylating agents as part of his chemotherapy regimen.
      - Suggest sperm banking prior to starting RT for men who wish to have children.
    - ii. Sterility in females
      - The use of inverted Y irradiation to the pelvic lymph nodes can cause early menopause as a result of ovarian exposure to radiation (Bruner, 2001).
      - Surgical manipulation of ovaries out of radiation field (oophoropexy)
      - Freezing embryos prior to radiation treatment
      - Androgens have been shown to improve low libido in some women who have undergone menopause (Bruner, 2001).
  - 10. Psychosocial and economic: Most challenging effect by both the survivors and healthcare providers. Severity of the problems is related to the developmental stage of the survivor (Fernsler & Fanuele, 1998).
    - a. Anxiety/fear of recurrence
    - b. Denial of insurance
    - c. Denial of job offers or rejection by the military
    - d. Body image
  - 11. Importance of healthy lifestyle
    - a. Diet
    - b. Exercise
    - c. Not smoking
    - d. Limit sun exposure
    - e. Breast self-exam
5. Patient and family education
- a. Teach patient and family about the required treatment and length of treatment depending upon treatment site.
  - b. Teach patient/family about the acute and late effects of treatment that they may experience depending upon their individual treatment site.
  - c. Teach patient and family about medications that may be used to minimize side effects of treatment.
  - d. Teach patient and family about appropriate healthcare risks associated with treatment and lifestyle modifications.
  - e. Teach patient and family about the need for long-term follow-up.

6. Follow-up management (Young, Bookman, & Longo, 1990)
  - a. Patients who are seen in follow-up may have appropriate diagnostic tests performed, including chest x-ray, thyroid panel, and CBC.
  - b. Patients should receive appropriate vaccinations, as necessary.

#### Modality-specific Management

##### A. External beam

1. Procedure description (Refer to the original guideline document for details)
2. Indications (Refer to the original guideline document for details)
3. Treatment
  - a. Simulation (Schell et al., 2001)
    1. The patient is placed on the simulator table or CT simulation table in a position that allows for treatment of the tumor volume without treating significant normal tissue. Supine is the most common position.
    2. An immobilization device may be made to assist in maintaining the treatment position. Examples of these devices include casts, head holders, bite blocks, thermoplastic face masks, and/or vacuum bags.
    3. Physical exam, CT scan, MRI, and surgical reports are used to define the target with the simulator's isocenter, and films are taken to determine if the target is correct.
    4. Information documented during simulation includes gantry angle, collimator angle, table position, and field size.
    5. Temporary or permanent marks are placed on the skin or immobilization device to be used in daily treatment setup.
    6. Computer-aided simulation uses a volumetric image of the patient in the treatment position with the entire process taking place within the computer using software tools to identify normal tissue and delineate treatment fields. This allows for more precise definition of the target volume and location of critical normal structures.
  - b. Treatment planning (Schell et al., 2001)
    1. Ensures that an adequate dose is delivered to the tumor while not exceeding normal tissue tolerance
    2. Information from simulation is used by the dosimetry staff to develop a plan, which is offered to the physician for approval.
    3. Treatment plan includes the number of treatments, dose per fraction, energy, prescription point location, and total dose. Treatment portals must cover the tumor volume with a margin.
    4. Gross tumor volume (GTV) includes the gross disease and abnormally enlarged regional nodes.

5. Clinical target volume (CTV) includes gross tumor volume plus regions considered to potentially have microscopic disease.
6. PTV includes a margin around the clinical target volume, which considers motion such as respiration and variations in the setup.

c. Treatment

1. Before the first treatment, a verification or portal film is taken to confirm setup is accurate. Port films are repeated on a weekly basis. The physician may check the patient on the machine before the first treatment is given.
2. Patients lay on the table for approximately 15 minutes or longer depending on the complexity of the setup, although the beam is only on for a few minutes (Bourland, 2000).
3. Treatments are given daily, Monday-Friday. If patients have twice-a-day treatment, at least six hours must elapse before giving the next dose (Rubin & Williams, 2001).

4. Collaborative management

a. Acute effects

1. General side effects, such as fatigue and anorexia, are experienced during EBRT.
2. Site-specific side effects (acute and late) are determined by the area treated, the total dose, and the influence of other modalities, such as surgery and/or chemotherapy. See the specific treatment sites.
3. Emotional reactions to therapy may also occur. Fears related to "being radioactive," and perceptions of therapy require ongoing assessment and intervention (Strohl, 1999).

b. Late effects

1. Late effects of EBRT are related to the total dose given, the energy of the beam used, and the treatment site. Late effects may include hypo- or hyper-pigmentation of the skin, atrophy and/or fibrosis of the skin and superficial tissues, and fibrosis of the deep tissue or organs. Tissue necrosis also may occur, resulting in an open skin wound and/or fistulae formation (Williams, Keng, & Sutherland, 2001).
2. Second malignancies (e.g., breast cancer following treatment for Hodgkin's disease) also may develop as late effects.

c. Management

1. Assess for comorbid factors such as smoking, recent surgery, and concurrent or recent chemotherapy, as these factors may alter tolerance and increase the incidence or severity of side effects (Rubin & Williams, 2001).

- a. Assess the patient's ability to tolerate treatment, both from the side effects as well as the social issues (e.g., transportation).
    - b. Obtain pretreatment nutritional assessment in patients with evidence of anorexia, significant weight loss, or obvious cachexia.
    - c. If patients have cardiac pacemakers/implantable defibrillators, contact the manufacturer before initiating radiation. Cardiac monitoring before, during, and afterward may be required (Haas & Kuehn, 2001; Hogle, 2002).
    - d. Careful treatment planning should be used to reduce both acute and late effects.
  - 2. Plan for at least once-weekly assessment during therapy.
- d. Patient and family education
  - 1. Educate the patient and family about the following aspects of RT. Describing the process of therapy as well as the anticipated side effects of treatment helps to prepare patients for therapy (Rutledge & McGuire, 2004).
    - a. What radiation is and how it works
    - b. Simulation and treatment planning process
    - c. Goal of therapy (prophylaxis, curative, palliative)
    - d. Importance of patient compliance with positioning. Sometimes analgesics may be ordered prior to treatment.
    - e. Anticipated side effects and methods to reduce effects
    - f. Role of communication between the radiation oncology staff regarding any side effects the patient experiences
  - 2. Preparing patients for therapy includes addressing fears about being irradiated. This is a modality that is difficult for most people to comprehend. The fact that an invisible beam of energy can destroy tumor cells seems unreal. The mystery associated with the therapy may lead to doubt and fear (Strohl, 1999).
  - 3. Repeated teaching needs to emphasize that persons receiving EBRT are not radioactive and that late effects are the result of biologic effects of radiation (Strohl, 1999).

## B. LDR/HDR brachytherapy

- 1. Procedure description (Refer to the original guideline document for details)
- 2. Indications (Refer to the original guideline document for details)
- 3. Potential risks
  - a. Acute and late effects of brachytherapy are those caused by effects of ionizing radiation (Bruner et al., 1998).
    - 1. Invasive brachytherapy procedures to various body sites carry risks of complications, such as perforation, infection, or bleeding (Bruner et al., 1998).

2. Complications associated with bed rest and catheterization include thrombophlebitis, pulmonary embolus, and urinary sepsis, especially for LDR brachytherapy (Bruner et al., 1998).
- b. Incidence: The majority of patients undergoing brachytherapy experience site-specific side effects related to the implant. In addition, the patients may have unresolved acute side effects of EBRT at the time of the implant because brachytherapy often is administered during or soon after the course of external beam treatment (Bruner et al., 1998; Velji & Fitch, 2001). Elderly or debilitated patients are more vulnerable to complications (Bruner et al., 1998).
- c. Assessment and management (see site-specific assessment and management for each implant site).
4. Procedure history and uses
  - a. Used since early 1900s following discovery of radium by Marie Curie (Dunne-Daly, 1997; Eifel, 1997; Hogle, Quinn, & Heron, 2003; Wright et al., 1994)
  - b. First used as surface applicators of radium to treat skin lesions (Dunne-Daly, 1997)
  - c. 1950s--development of afterloaders (Dunne-Daly, 1997)
    1. Source holders (applicators) placed in outpatient clinic or while in surgery
    2. Source loaded when patient was in radiation procedure room or returned to radiation-safe inpatient room
    3. Reduced exposure to healthcare provider
  - d. 1960s-70s--decline in use because of the development of linear accelerators
  - e. 1980s--renewed interest (Dunne-Daly, 1997)
    1. Single modality
    2. Combination with other modalities (external beam, hyperthermia)
  - f. Currently widely used (Dunne-Daly, 1997)
    1. Knowledge of long-term effects
    2. Improved safety and protection techniques
    3. Increased knowledge regarding care of implant patients (DeVita, Hellman, & Rosenberg, 2001). Brachytherapy requires the expertise of a team of trained personnel (physician, physicist, dosimetrist, radiation therapist, RT nurse, and radiation safety officer) to implement the individualized treatment plan designed by the radiation oncologist.
      - a. Brachytherapy has a variety of current uses alone or in combination with other therapies and in specific cancers.
      - b. Brachytherapy is used to improve local tumor control.
        - i. Gynecologic cancers (Dunne-Daly, 1997; Eifel, 1992, 1997; Fieler, 1997; Gosselin & Waring, 2001; Gupta et al., 1999;

- Holland, 2001; Mock et al., 2001; Wright et al., 1994)
    - Vaginal cylinder/stump
    - Tandem and ovoids
    - Interstitial needles and template
  - ii. Head and neck (Devine & Doyle, 2001; Dunne-Daly, 1997; Kremer et al., 1998)
    - Intracavitary catheters
    - Interstitial catheters
  - iii. Lung (Bruner et al., 1998; Dunne-Daly, 1997; Fieler, 1997; Powell, 1999)
    - Endobronchial catheters
    - Interstitial catheters
  - iv. Breast (Dunne-Daly, 1997; Hogle, Quinn, & Heron, 2003)
    - Interstitial catheters
    - Applicators
    - Inflatable catheters
  - v. Prostate
    - Radioactive seed implant (permanent/LDR)
    - Radioactive seed implant (temporary/HDR)
- g. Brachytherapy irradiates small volumes and can potentially minimize complications (Nag et al., 2001). Brachytherapy is used to preserve vital organ function.
  - 1. Soft tissue sarcoma
  - 2. Oropharyngeal cancers
  - 3. Intraocular melanoma, retinoblastoma
  - 4. Meningiomas
  - 5. Malignant brain tumors (Bruner et al., 1998)
- h. Brachytherapy is used to treat recurrent or inoperable cancers.
  - 1. Lung cancer (bronchogenic)
  - 2. Esophageal cancer (Bruner et al., 1998)
- i. Brachytherapy is used to control disease in previously radiated sites.
  - 1. Recurrent gynecologic (GYN) cancers
  - 2. Head and neck cancers
  - 3. GI malignancies (Bruner et al., 1998)
- j. Isotopes and techniques used with various cancers: Most current brachytherapy performed with reactor-produced radionuclides (Bruner et al., 1998)
  - 1. Safer
  - 2. Easier to use
    - a. Cesium-137
    - b. Iridium-192
    - c. Iodine-125
    - d. Palladium-103
    - e. Gold-198
  - 3. Mechanism of action (Dunne-Daly, 1997)
    - a. Alpha, beta, and gamma rays transfer energy to living matter.
    - b. Ionization of molecules in cells

- c. Cellular reproduction process altered
  - d. Irradiated cells destroyed instantly
  - e. Irradiated cell unable to reproduce
  - f. Extent of injury related to capabilities of isotope
- 4. Isotopes and techniques used in brachytherapy (see Table 15 in the original guideline document)
- k. LDR/HDR brachytherapy
  - 1. Conventional LDR brachytherapy involves an operative procedure with anesthesia for placement of a hollow applicator device or catheter into body tissues or cavities. Radioactive sources are manually afterloaded into the applicators after the patient has returned to the designated hospital room (Bruner et al., 1998; Dunne-Daly, 1997). With post-op soft tissue sarcomas, no radiation is administered for at least five days to allow for wound healing (Carrubba, Jankowski, & Kunsman, 1999).
    - a. Hospitalization and specialized nursing care are required while the implant remains in place, which may be from one to several days.
    - b. Bed rest is required for gynecologic, some prostate, and rectal implants.
    - c. LDR brachytherapy also can be performed using remote afterloading techniques.
    - d. Strict room confinement is required for all inpatient brachytherapy (see section III of the original guideline document).
    - e. Invasive brachytherapy procedures to various body sites carry risks of complications such as perforation, infection, and bleeding (Bruner et al., 1998).
  - 2. HDR brachytherapy involves the use of an automated remote afterloading device for the placement of the radioactive source into the applicators, which have been placed in the tumor/cavity (see Figure 15 in the original guideline document). Sources are loaded from a storage safe that is in the afterloader and delivered via source guide tubes that connect the afterloader to the patient's treatment device, which are attached to the applicators inside the patient (Bruner et al., 1998).
  - 3. HDR brachytherapy allows patients to be treated with a high dose of radiation in a short period of time as outpatients, with minimal radiation exposure to healthcare providers (Dow et al., 1997). Generally, the HDR treatments are repeated until the desired dose has been delivered (Holland, 2001).
    - a. The use of HDR treatment is possible in virtually all sites treated by conventional LDR therapy and by intracavitary, interstitial, intravascular, mold, percutaneous, or intraoperative techniques, with advantages for pediatric or adult patients. In selected instances, HDR appears to be well tolerated and as effective as LDR (Mock et al.,

2003). Patients state a variety of reasons (traveling distance most often cited) for preferring LDR or HDR, when given the option (Wright et al., 1994).

- b. Anesthesia or sedation may be required depending on the site, applicator, and age/comprehension of the patient; however, these procedures generally are performed on an outpatient basis with or without sedation/anesthesia (Eifel, 1992).
- c. Treatment times are shorter, but more treatments may be needed. Caregivers and visitors are not subject to radiation exposure after the patient is discharged (Brandt, 1991).

#### 5. Collaborative management

- a. Gynecologic implants, LDR: Applicators include intracavitary tandem and ovoids, vaginal cylinders, and transperineal interstitial vaginal template and needles (for advanced gynecologic malignancies) (Gupta et al., 1999).
  - 1. Pretreatment bowel preparation regimen per institution (i.e., enema morning of implant)
  - 2. Strict bed rest with log roll for care is mandatory to prevent possible dislodgment of applicator(s). In addition, a Foley catheter is inserted. Moistened vaginal packing is used to secure the position of the applicators and to pack the bladder and rectum away from the vaginal sources (Eifel, 1997). The applicator also may be held in place with radiation briefs and/or by suturing. Bowel management with antidiarrheal medication is given; low-residue diet (with finger foods) for nutrition is provided; head of bed should be raised no higher than 30 degrees. Check position of implant every shift and as necessary; modify bathing and linen change. Instruct patient on care guidelines and rationale while on bed rest (Gosselin & Waring, 2001).
  - 3. Prevent complications of immobility by use of compression stockings, coughing/deep breathing postoperatively, isometric exercises, and anticoagulants, if ordered (Bruner et al., 1998).
  - 4. Promote patient's comfort and decrease procedure-related pain with use of analgesics (oral, IV, patient-controlled analgesia, transdermal, epidural). Evaluate pain control each shift and more frequently if needed. Strong analgesia required ½ to 1 hour prior to removal of applicators (especially the interstitial needles and template, which could cause more pain during removal than other applicators). Pressure and ice applied to perineum for five minutes or longer after removal of needles to minimize bleeding and improve comfort (Bruner et al., 1998; Gosselin & Waring, 2001).
  - 5. Decrease social isolation; keep items within reach (call bell, hydration, tissues); answer call light promptly,

- check on patient often; educate patient per rationale of isolation.
6. Address issues of long-term effects of vaginal stenosis. Prescribe and educate patient per use of vaginal dilator. Address concerns regarding sexuality. Patients receiving brachytherapy have a variety of informational needs and prefer to be fully informed about their conditions (Brandt, 1991).
  7. Refer to institutional radiation safety guidelines for exposure limits for staff, family, and other visitors (see section III--Radiation Protection above and in the original guideline document).
  8. Provide patient with discharge instructions and contact telephone numbers. Report any excessive bleeding from bladder, vagina, or rectum; excessive pain; foul odor of urine or vaginal drainage; temperature above 101 degrees F, increased urinary frequency or dysuria; inability to void after four hours; and diarrhea not controlled with diet or antidiarrheal medications (Gosselin & Waring, 2001).
  9. Educate staff caring for patient about the applicator, source, and rationale. Lack of knowledge of staff members can contribute to fear on the caregivers' part (Gosselin & Waring, 2001; Stajduhar et al., 2000; Sticklin, 1994; Velji & Fitch, 2001).
- b. Gynecologic implants, HDR: Applicators include tandem and ovoids and ring type or vaginal cylinders/stumps.
1. Teach patient and family what to expect during the treatment. The aspects of treatment context, symptomatology, and passage of time are important to address during and after brachytherapy (Velji & Fitch, 2001).
  2. Provide special instructions, if any, such as eat light breakfast, take regular medications, and take antidiarrheal medication if necessary.
  3. Brachytherapy applicators need to be stabilized/anchored in place to ensure accuracy of placement of sources. There are several ways to accomplish this. With gynecologic patients using tandem and ovoid applicators, the applicators are stabilized after insertion with gauze packing to minimize movement while transporting patient. After packing is complete, the device should be further stabilized by suturing the labia or using a more humane approach, such as Radiation Implant Briefs™ (see Figure 16 in the original guideline document).
  4. Assess and prepare the patient upon arrival to the clinic. Have the patient put on a pair of Radiation Implant Briefs. A Foley catheter and rectal tube will be inserted prior to the applicator being placed. Premedicate with oral pain medication and antianxiety medication, if necessary.

5. The patient should be monitored throughout the preparation and procedure.
  6. Instruct the patient upon discharge about problems to report (e.g., increased urinary frequency or dysuria, foul odor of urine or vaginal discharge, fever, increased pain, heavy bleeding) (Gosselin & Waring, 2001) (see Table 16 in the original guideline document).
  7. Educate per pelvic site-specific management, such as vaginal stenosis and sexuality issues (see Figure 17 in the original guideline document).
- c. Head and neck implants, LDR: Plastic catheters are afterloaded with iridium seeds.
1. Prevent respiratory or cardiovascular complications by encouraging routine post-op exercises (e.g., deep breathing, changing position in bed, ambulating inside room), if appropriate.
  2. Prior to implant, patient to receive aggressive bowel regimen to decrease chance of dislodging radioactive sources while straining during bowel movement (Devine & Doyle, 2001).
  3. Have tracheostomy set in room; tracheostomy may be performed for airway obstruction resulting from edema (Bruner et al., 1998).
  4. Prior to implant, teach patient techniques for self-suctioning, oral hygiene, and tracheostomy care if indicated (Bruner et al., 1998; Devine & Doyle, 2001).
  5. Provide nutrition and fluids during implant with soft or liquid diet, nasogastric tube, or IV hydration (Bruner et al., 1998). Although some patients receiving head and neck implants can be allowed to sip a liquid formula through a straw, most are fed through a nasogastric tube (Perez & Brady, 1998).
  6. Promote comfort by medicating as needed with NSAIDs or narcotic analgesics. Avoid overmedication, which can result in suppression of cough reflex or respirations.
  7. Prior to implant, assess patient's ability to read and write. Provide tools for communication if needed (e.g., pen, paper, white board with marker). If patient is illiterate, provide alternate communication strategies (e.g., cards with commonly needed items or nursing care procedures pictured). Intensive patient and family education reduces stress about procedure (Devine & Doyle, 2001).
  8. Inspect implant site every shift for intactness. Discourage patient from touching site. Exact placement of the applicator is crucial for the result of radiotherapy (Kremer et al., 1999).
- d. Lung implants, HDR or LDR: Treatment—Endobronchial catheters are placed during fiberoptic bronchoscopy, and iridium-192 seed ribbons are temporarily applied (Bruner et al., 1998) (see Figure 18 in the original guideline document).
1. HDR is an outpatient procedure.

- a. The patient is NPO (nothing by mouth) for 8 to 12 hours before the procedure. Vital signs and oxygen saturation are monitored and an IV is started.
  - b. The nurse prepares the patient for bronchoscopy through which a catheter is guided to the tumor area.
  - c. IV sedation (e.g., diazepam, versed, fentanyl), a local anesthetic (e.g., topical lidocaine [aerosol or viscous]), and additional medications (atropine, epinephrine) may be administered to keep patient comfortable and minimize gag reflex during procedure (Powell, 1999).
  - d. The patient may be discharged to a responsible party when vital signs are stable, gag reflex returns, and patient is able to ambulate (Powell, 1999).
2. LDR is an inpatient procedure.
- a. The patient receiving LDR requires hospitalization for two to seven days, depending on the radioactive source strength (Dow et al., 1997).
  - b. After bronchoscopy and placement of the catheter, the patient is placed in a radiation safety-approved room (see section III of the original guideline document) where the radioactive source is loaded.
  - c. The registered nurse (RN) monitors for complications such as bleeding, infection, and/or respiratory compromise. Cough suppressant medication may be needed.
  - d. Patient is discharged after radioactive source and catheter are removed and the patient is stable.
- e. Eye plaques: Used in retinoblastoma, most common in pediatric patients and young adults; ocular/choroidal melanoma is most common in adults (Halperin et al., 1999). Plaque radiotherapy is effective in the management of cases that otherwise would have been managed with enucleation (Shields et al., 2003).
1. LDR
  2. Performed in operating room with ophthalmologic surgeon (adult, pediatric)
  3. Radiation physicist also present
  4. Equipment for I-125 ocular plaque construction and placement includes a dummy plaque to aid in the placement of the necessary retention sutures, a gold backing with lug holes for sutures, and a plastic insert to hold the radioactive I-125 seeds (Halperin et al., 1999) (see Figure 19 in the original guideline document).
  5. Other types of plaques using various isotopes also are available.
  6. Patient (pediatric) with retinoblastoma is hospitalized 40-50 hours (35-40 Gy)

7. Patient (adult) with ocular melanoma is hospitalized two to five days (85 Gy to the prescriptive point) (DeVita, Hellman, & Rosenberg, 2001).
8. Special care for both adult and pediatric patients would be to protect affected eye from trauma (creative, occlusive bandaging for the pediatric patient).
9. Acute effects are pain and operative infection.
10. Long-term effects are cataracts.

6. Patient and family education

- a. Educate patient and family on type of implant, rationale, procedure, preparation, sensory information, availability of pain medication, and care during treatment specific to type of implant (Bruner et al., 1998). Intensive patient and family education about the brachytherapy procedure, necessary visitation restrictions, and the anticipation of potential patient problems is instrumental in preventing complications (Devine & Doyle, 2001). Patients receiving HDR brachytherapy experience side effects similar to those caused by external radiation treatments, with fatigue being the most often reported symptom (Fieler, 1997).
- b. Discuss rationale and methods for radiation protection, self-care during implant, and limitations on staff and visitor time in room (see section III of the original guideline document).
- c. Provide verbal and written discharge instructions with guidelines for activity, bathing, skin or wound care, diet, smoking restrictions (bronchoscopy), alcohol restrictions, medication guidelines, and symptoms to report to a doctor or nurse. Be sure to include telephone numbers for daytime and after hours.
- d. Instruct per early and late side effects, address specific questions and concerns, and provide follow-up appointment information.

7. Brachytherapy for benign disease

- a. Pterygium: An elastotic degeneration of collagen that produces a fleshy mass in the bulbar conjunctiva that grows across the cornea, interfering with vision (Dow et al., 1997)
- b. Caused by repeated irritation to the eyes (e.g., welding, woodwork, sun, sand)
  1. Treatment
    - a. Strontium-90, surface application
    - b. 10 Gy weekly, for six weeks (Paryani et al., 1994)
  2. Rationale (Dunne-Daly, 1997; Paryani et al., 1994)
    - a. Primary treatment is surgery.
    - b. High rate of regrowth with surgery
    - c. Brachytherapy can decrease recurrence rates.

8. Related Web sites (Refer to the original guideline document for details)

C. Prostate brachytherapy

1. Procedure description (Refer to the original guideline document for details)
2. Indications: Differs according to LDR and HDR (Refer to the original guideline document for details)
3. Treatment
  - a. LDR: Consists of inserting needles directly into the prostate gland under the guidance of transrectal ultrasound. This is an operative procedure during which the patient can undergo either general or epidural anesthesia, although there are reports of patients having undergone the procedure with local anesthesia (Smathers et al., 2000). Small radioactive seeds then are placed into the gland through the needles.
    1. Sources most commonly used include the following radioactive isotopes (Iwamoto & Maher, 2001).
      - a. Iodine 125 (I-125)--having a 60-day half-life.
      - b. Palladium 103 (Pd-103)--having a 17-day half-life.
    2. The number of needles used depends on the size of the prostate gland. Typically, 18 to 30 needles are inserted and immediately removed following the procedure. A typical prostate will receive 70 to 100 seeds (University of Pittsburgh Medical Center [UPMC], 2003).
  - b. HDR
    1. An operative procedure during which a template is secured to the perineum, and, under the guidance of transrectal ultrasound, needles are inserted through the holes in the template and into the prostate gland. As the needles are removed, plastic catheters are left in place and secured by way of the template.
    2. After radiation planning is complete, the catheters are secured to an HDR afterloader, and the radiation source is directed into and out of each catheter. Iridium dwell time varies according to source strength and radiation plan.
    3. Typically, treatments are given in three fractions at approximately 6 Gy each, although some clinicians administer HDR treatments in two or four fractions at doses ranging from 5.5 to 10.5 Gy (Martinez et al., 2000, 2001).
    4. This procedure requires overnight inpatient hospitalization and interstitial catheter care to be administered by either radiation oncology nurses or inpatient staff nurses (Cancer Treatment Centers of America, 2003; Martinez et al., 2000, 2001).
    5. The most commonly used isotope is iridium-192.
4. Side effects (Refer to the original guideline document for details)
5. Collaborative management for LDR: Predominantly outpatient procedure
  - a. Acute effects

1. Educate patients about the differences between palladium and iodine implant (half-life, exposure precautions).
2. Inform patient and family of acute and late effects.
3. Indwelling catheter may be required until acute postoperative swelling of smooth muscle decreases and urinary obstructive symptoms subside.
4. Collect and monitor urine for the first 24 hours following implant (Perez, Zwickler, & Williamson, 2004).
5. If a displaced seed is found, place in a container and return to radiation oncology department as soon as possible.
6. Educate patient and family about exposure precautions as indicated by institutional policy (see patient/family education).
7. Administer and educate about side effects of medications prescribed to alleviate urinary or bowel morbidity.
8. Urinary-specific management (see section V, G--Male Pelvis/Prostate above and in the original guideline document)
9. Bowel management (see section V, G--Male Pelvis/Prostate in the above and original guideline document)
10. Proctitis (see section V, G--Male Pelvis/Prostate above and in the original guideline document)

b. Late

1. Patient and spouse may need to be referred for professional counseling regarding the physical and psychological effects of sexual dysfunction.
  - a. Encourage communication regarding fears/concerns of sexual dysfunction (Bruner et al., 1998).
  - b. Identify resources that may be helpful in managing the effects of sexual dysfunction (e.g., sex therapist, counselor, physician, books, pamphlets) (Barsevick, Much, & Sweeney, 2000).
2. Administer appropriate medication as prescribed.
  - a. Sildenafil--25-100 mg 30 minutes to 4 hours before sexual activity. A phosphodiesterase-5 (PDE5) inhibitor, this drug works by enhancing the effects of nitric oxide released during sexual stimulation, which eventually promotes smooth muscle relaxation of the corpus cavernosum, thereby promoting increased blood flow and subsequent erection (Deglin & Vallerand, 2003). Teloken (2001) reported successful treatment with sildenafil among patients who have received RT to the prostate has ranged from 70%-80%.
  - b. Other PDE5 inhibitors, such as tadalafil or vardenafil HCl, work similarly to sildenafil and may be useful in treating impotence. However, no studies currently are known that have

- examined the effectiveness of tadalafil or vardenafil among patients treated with RT.
    - 3. Referral to urology for other alternative treatments
      - a. Other nonsurgical approaches include urethral suppositories, intracavernous injections, and vacuum devices.
      - b. Penile prostheses have yielded satisfaction rates of up to 85% (Mulcahy, 2000).
  - 6. Collaborative management for HDR prostate brachytherapy (brachytherapy catheter care)
    - a. Keep area open to air as much as possible.
    - b. Keep perineal template as clean as possible.
    - c. Some discharge may occur while catheters are in place; frequent pad changes may be necessary to maintain patient hygiene and comfort.
    - d. Decrease bowel movements while catheters/template in place.
      - 1. Loperamide hydrochloride (see information presented earlier for dosing)
      - 2. Low-fiber diet (Iwamoto & Maher, 2001)
    - e. Minimize patient activity to avoid brachytherapy catheter displacement and maintain patency of indwelling urinary catheter.
    - f. Collect and monitor urine for the first 24 hours post-implant (Perez, Zwickler, & Williamson, 2004).
    - g. Inpatient staff nurses need to be aware that patient is not radioactive and exposure precautions are unnecessary for HDR prostate brachytherapy patients as long as they are not connected to the remote afterloader for treatment administration.
    - h. Administer pain medications as needed for postoperative discomfort, acute and late urinary and bowel morbidity, as well as late effect potency issues.
  - 7. Patient and family education (Refer to the original guideline document for details)
- D. Accelerated partial breast irradiation
- 1. Procedure description (Refer to the original guideline document for details)
  - 2. Indications (Refer to the original guideline document for details)
  - 3. Treatment: A variety of treatment approaches are available to provide partial breast irradiation.
    - a. External beam: The treatment is given via one of three external beam treatment modalities, usually four to six weeks after surgery. The fields are designed to cover the tumor bed and a small rim of tissue surrounding it (El-Ghamry et al., 2003).
      - 1. 3-D conformal radiotherapy
      - 2. IMRT
      - 3. Proton beam radiation

- b. Brachytherapy: The treatment is given either at the time of surgery or at a later time through a special set of catheters in the tumor bed.
  - 1. (1) LDR interstitial implant: Uses standard catheters that are placed either at the time of surgery or at a later time. The catheters are placed through the skin and lie under the tumor bed. They are loaded at a later time with iridium-192 sources and remain in place for the prescribed length of treatment (hours).
  - 2. HDR brachytherapy: Uses standard catheters that are placed either at the time of surgery or at a later time. The catheters are placed through the skin and lie under the tumor bed. They are loaded at a later time for the prescribed dose, usually once or twice a day for five days, after which the catheters are removed.
  - 3. MammoSite® RTS (Texas MammoSite, San Antonio, TX): Catheter placement is performed either during the surgical procedure under general anesthesia or in an outpatient procedure room under local anesthesia. The MammoSite catheter is inserted into the surgical cavity through a separate pathway created by a trocar, or via the lumpectomy scar. The MammoSite catheter is inflated with saline and contrast agent to allow the surrounding tissue to conform to the balloon, the exit site is dressed, and the patient is sent home. Once the patient has sufficiently recovered from surgery, radiation therapy is provided on an outpatient basis. During therapy, an iridium-192 seed (attached to a HDR remote afterloader) is inserted into the inflated balloon for a short duration (typically less than 10 minutes). When radiation therapy is concluded, the balloon is deflated, and the MammoSite catheter is removed (Vaidya et al., 2002).
  - 4. The Intrabeam® System (Zeiss, Oberkochen, Germany): The radiation dose is administered to the tumor bed in the operating room following lumpectomy. This system uses the miniature x-ray source, a highly stable support stand, and a full range of applicator options. The surgeon removes the tumor and then directly places the applicator into the tumor bed. By administering the prescribed dose to that site, the highest dose is concentrated within the tissue adjacent to the applicator surface. Following the treatment delivery, the applicator and miniature x-ray source are removed, the surgical site is closed, and the procedure is complete (Zeiss, 2003).

#### 4. Collaborative management

##### a. Acute effects

- 1. Pain at the wound and catheter site (Baglan et al., 2003)
- 2. Mild erythema of the skin and hyperpigmentation (Baglan et al., 2003)

3. Drainage around wound (Keish et al., 2003)
  4. Ecchymosis (Keish et al., 2003)
  5. Cellulitis
  6. Abscess development in the wound (Lawenda et al., 2003)
  7. Hematoma in the wound (Lawenda et al., 2003)
  8. Bleeding after catheter removal (Lawenda et al., 2003)
  9. Nonhealing sinus tract requiring surgical excision (Lawenda et al., 2003)
  - b. Late effects (Lawenda et al., 2003)
    1. Moderate to severe scarring and thickening of the skin and breast
    2. Abnormal-appearing post-treatment mammograms, including seromas, calcifications, fat necrosis, and architectural distortion
5. Patient and family education (Hogle, Quinn, & Heron, 2003)
- a. Teach patient and family about the treatment procedure and the time required for the treatment.
  - b. Teach patient and family about wound care procedures to manage catheters after discharge from hospital (if going home with catheters in place).
  - c. Teach patient and family about signs and symptoms of infection to report, including increased pain, erythema, wound/catheter discharge, and temperature over 101 degrees F.
  - d. Teach patient and family how to care for wound and breast after catheter removal.
  - e. Teach patient and family about possible delayed wound healing, which can be attributed to radionecrosis of the wound edge (Vaidya et al., 2001, 2002).
6. Follow-up
- a. Follow-up examinations are performed at three month intervals during the initial one to two years or per protocol if the patient is enrolled by the surgeon and radiation oncologist.
  - b. Ipsilateral mammograms usually are performed within 3-6 months after procedure and then every 6-12 months until stable, then once a year. If patient is on study protocol, the mammogram frequency may be different.
- E. Intravascular brachytherapy
1. Procedure description (Refer to the original guideline document for details)
  2. Indications (Refer to the original guideline document for details)
  3. Treatment
    - a. Intravascular brachytherapy (IVBT), used in conjunction with percutaneous transluminal coronary angioplasty (PTCA), temporarily implants radioactive material, either gamma or beta irradiation. The type of radiation selected will determine the amount of radiation and dwell time (Hanefeld et al., 2002).
    - b. IVBT is performed in the cardiac catheterization laboratory. The multidisciplinary responsibilities include the following.

1. Interventional cardiologist--Initially inserts the coronary catheter, determines the injury length and reference vessel diameter, and inserts the IVBT catheter. Essentially oversees the overall medical safety of the patient.
2. Radiation oncologist--Ensures the accurate delivery of the RT to the target area, making decisions related to dose delivery, prescription point, source delivery, and recovery, as well as safe completion of the removal of radioactive sources. Oversees the radiation safety of the procedure.
3. Medical physicist--Ensures radiation safety storage, disposes of radiation sources, monitors radiation exposure to personnel, and measures patient dosimetry (calculations of treatment times, dose distributions, and advising on maximum tissue doses).
4. Catheterization personnel (cath lab technicians and nurses)--Assist in the overall cardiac catheterization procedure and obtain any extra special equipment for IVBT.

#### 4. Radiation safety issues

- a. Source inventory (gamma or beta)
- b. Storage between patient cases
- c. Certification for potential uses
- d. Calibration of treatment delivery device
- e. Shielding, handling, and disposal of radioisotopes
- f. Safety with catheterization laboratory (film and ring badges to monitor exposure)
- g. Emergency bailout procedures for lost sources, liquid radionuclide spills, failure of delivery, and retraction of sources for manually afterloaded and remote afterloaded machines

#### 5. Collaborative management

- a. Acute effects--Complications can occur from the heart catheterization and/or the brachytherapy.
  1. Major complications from heart catheterizations
    - a. Severe hypotension
    - b. Anaphylactic shock
    - c. Dissection of the coronary or femoral arteries
    - d. Femoral occlusion from the catheterization
    - e. Stroke
    - f. Arrhythmias
  2. Major complications from brachytherapy
    - a. Late thrombosis
    - b. Late restenosis
    - c. "Edge effect"--closing at the ends of the treatment areas
- b. Late effects--Original patient cohorts from first clinical trials are being followed for long-term risks associated with the use of radiation to the coronary arteries (Nguyen-Ho et al., 2002). In animal and human studies, aneurysm, fibrosis, and restenosis

at the edge or within the vessel have been reported (Fox, 2002; Waksman, 1999).

6. Patient and family education: Typically, radiation oncology nurses are not directly involved in the care of patients on IVBT; rather, patient teaching is the focus.
  - a. Knowledge about IVBT to support the patient's decision process and informed consent
  - b. Discussion of the roles and responsibilities of the multidisciplinary team
  - c. Cardiology nurses are available to explain heart catheterization and answer questions pertaining to interventional procedure.
  - d. Patients are not radioactive after the procedure; the only exposure is during the cardiac catheterization.
  - e. Patients will have antiplatelet therapy after the procedure (duration is determined by cardiologist).
  - f. Long-term follow-up is predominantly with the cardiologist.

F. Intraoperative radiation therapy (IORT)

1. Procedure description (Refer to the original guideline document for details)
2. Indications (Refer to the original guideline document for details)
3. Treatment
  - a. The use of IORT was first reported in the early 1900s, and the technique has continued to develop over the past century (Wojtas & Smith, 1997).
  - b. Wolkov (1998) identified the following advantages with the use of IORT.
    1. Ability to treat large volumes
    2. Homogeneous dose distribution
    3. Potential to limit tumor seeding
    4. Avoidance of trauma to normal tissues associated with interstitial implantation
    5. Limited to no dose to surrounding normal structures because of mobilization and direct shielding
  - c. IORT can be delivered with high-energy electrons (IOERT), an orthovoltage unit, or an HDR gamma-emitting isotope (HDR IORT). The first two methods require a portable electron unit and/or a linear accelerator, whereas the third requires a portable HDR remote afterloader. Each of these treatment units has specially designed applicators that come in different sizes that are attached to the unit. Cones that are used for other types of radiation treatment may be used on the linear accelerator and/or on the mobile electron linear accelerator. The Harrison-Anderson-Mick (HAM) applicator was developed at Memorial Sloan-Kettering Cancer Center and is a 1 cm thick pad made of flexible material ("super flab"), with source guide tubes running through the center and a cap at the end that secures the source guide tubes, which then attach to the remote afterloader (Harrison, Enker, & Anderson, "High-dose

rate intraoperative radiation therapy for colorectal cancer, Part 1," 1995).

- d. Two challenges exist with a linear accelerator-based program (Harrison, Enker, & Anderson, "High-dose rate intraoperative radiation therapy for colorectal cancer, Part 1," 1995).
  - 1. Transferring of the patient from the operating room (OR) to the radiation department and the various risks associated with this.
  - 2. Having a dedicated accelerator in an OR is often considered cost prohibitive based upon patient treatment volumes.
- e. If IORT is going to be given in the OR, then the OR needs to be shielded and another set of monitoring equipment needs to be outside of the room to be used during IORT.
- f. Preoperative care
  - 1. In an effort to determine tumor size, location, and extent of disease preoperatively, the patient may need to undergo numerous invasive and/or noninvasive procedures.
  - 2. Patients also will undergo all required preoperative studies, including chest x-ray, EKG, and other laboratory studies as deemed necessary.
  - 3. Informed consent for the procedure should be ascertained from the patient by the multidisciplinary team prior to the day of surgery.
  - 4. Patients will have necessary catheters, tubes, and IVs started prior to surgery.
- g. Intraoperative care
  - 1. The surgical team (e.g., physician, nurse) provides status updates to the radiation oncologist about the patient and what time he or she will be ready for the radiation oncologist and medical dosimetrist in the OR.
  - 2. During an operation, the normal organs are physically moved out of the pathway of the radiation beam (Harrison, Enker, & Anderson, "High-dose rate intraoperative radiation therapy for colorectal cancer, Part 1," 1995), whenever possible.
  - 3. If the patient is to be transported to the radiation oncology department to receive radiation, the following needs to occur.
    - a. Incisions are temporarily closed with a running continuous suture or clamps, and the wound is covered with a sterile adhesive dressing.
    - b. Patient is placed on a stretcher and transported to the department with portable anesthesia.
    - c. Patient then is transferred to the treatment couch and reprepared and redraped.
    - d. After involved personnel are regowned and regloved, the surgeon reopens the incision, and

the treatment applicator is placed (Wolkov, 1998).

4. When the radiation oncologist and medical physicist arrive, they will scrub into the case and examine the area that is to be treated. The resected specimen often is reviewed with the pathologist, and the margins are analyzed by frozen section. The desired treatment applicator is selected and secured in place, and appropriate shielding will be placed to protect the normal tissue.
5. The radiation oncologist prescribes the treatment dosage, and the medical physicist performs the dose calculations. If using the Harrison-Anderson-Mick (HAM) applicator, source guide tubes will need to be connected to the applicator from the HDR unit.
6. When the treatment is delivered, the team leaves the room and monitors the patient on another set of equipment outside of the OR.
7. Depending on the total dose to be delivered and the activity of the source, treatment time will vary (Harrison, Enker, & Anderson, "High-dose rate intraoperative radiation therapy for colorectal cancer, Part 2," 1995). For HDR, it is approximately 25 minutes.
8. Although not done frequently, the patient may receive more than one fraction during the procedure because of the size of the area that needs to be treated.
9. Generally, clips are later placed around the irradiated site volume so that it can be visualized radiographically later, at the time of a subsequent external beam treatment simulation (Wolkov, 1998).
10. Once treatment is completed, the treatment applicator and lead shields (if HDR) are removed. The surgeon closes the incision, and the nurses complete the closing sharps, sponge, and instrument counts (Domanovic et al., 2003).
11. Prior to transferring the patient, report is called to the registered nurse in the postanesthesia care unit (PACU).

#### h. Postoperative care

1. Depending upon the patient, once he or she is in the postanesthesia care unit and stabilized, he or she will be transferred to an intermediate care unit or an intensive care unit.
2. The nurse caring for the patient who received IORT needs to be knowledgeable about the surgical procedure performed, the typical complications that arise from that type of surgery, as well as issues related to the surgical resection and any anastomoses performed.

#### 4. Collaborative management

##### a. Acute effects

1. Complications that could occur in any patient receiving a major surgical procedure include infection, abscess, fistula, bleeding, or obstruction (Wojtas & Smith, 1997).
  2. Patients may experience pain, altered bowel patterns, and nutritional issues related to the surgical procedure.
- b. Late effects
1. Patients may have sexuality issues related to the surgical intervention and IORT, the use of pre- or postoperative radiation, and/or chemotherapy.
  2. Azinovic et al. (2001) found the incidence of severe toxicity was lower in gynecologic, head and neck, and genitourinary (GU), whereas higher toxicity was noted in bone sarcomas and soft tissue sarcomas.
  3. Peripheral nerve injury was the dominant event in long-term survivors (Azinovic et al., 2001). This event appeared most frequently in those locations in which a peripheral nerve is commonly found in the surgical bed (Azinovic et al., 2001).
  4. The development of IORT-induced neuropathy appears related to
    - a. Recurrent disease treated with prior surgery and/or EBRT
    - b. Overlap of matching IORT fields
    - c. Total IORT dose to the nerve
    - d. Volume irradiated (Wolkov, 1998).
  5. Other side effects that may arise depending upon the treatment area include ureteral and bile duct stenosis and fibrosis, hydronephrosis, pelvic fibrosis, limb edema, and cystitis (Azinovic et al., 2001; Wolkov, 1998).

5. Patient and family education

- a. Teach patient and family about the required studies prior to surgery and the length of time required for the studies.
- b. Teach patient and family about the surgical procedure and the radiation treatment. Review with them nothing by mouth status, GI prep if ordered, and where and when to arrive for surgery if the patient is not to be admitted the evening before.
- c. Teach patient and family about discharge care that may include wound care, dietary needs, and ostomy care and who to contact if issues should arise.
- d. Provide patient and family, if applicable, with counseling on sexuality as well as resources, such as American Cancer Society's (ACS's) ("Sexuality and cancer for the man who has cancer and his partner," "Sexuality and cancer for the woman who has cancer and her partner," 2001) Sexuality and Cancer booklets.
- e. Provide appropriate referrals to services that may include social work, vocational counseling, and pastoral support.
- f. Teach patient about treatment planning, EBRT, skin care, and acute and late side effects, if he or she is to receive postoperative radiation.
- g. Teach patient and family the signs and symptoms of peripheral neuropathy and how to manage this side effect.

- h. Teach patient and family the importance of follow-up care to assess for acute and late effects.

6. Follow-up

- a. Patients may be seen frequently over the first few months post-treatment for assessments and to determine their response to treatment.
- b. The surgical oncologist in conjunction with the radiation oncologist may follow patients.

G. Stereotactic radiosurgery/radiotherapy

1. Stereotactic radiosurgery (SRS)

- a. Procedure description (Refer to the original guideline document for details)
- b. Indications (Refer to the original guideline document for details)
- c. Treatment

1. Technology

- a. Positively charged particles (protons) (Kirn, 1988)
- b. Gamma radiation (Gamma Knife emitted from a fixed array of 201 small cobalt-60 sources) (see Figure 20 in the original guideline document) (Flickinger, Lundsford, & Kondziolka, 1994; Lundsford, Alexander, & Loeffler, 1993)
- c. Linear accelerator (LINAC)-based stereotactic techniques using circular collimators or micro-multileaf collimators
- d. CyberKnife® (Accuray Inc., Sunnyvale, CA) uses the skeletal structure of the body as a reference frame for localizing the target instead of a rigid body or head frame that is commonly used. A small linear accelerator is mounted on a robot, and the computer controlling the radiation beam makes constant tiny corrections for the slightest movements.

2. Immobilization

- a. Uses stereotactic apparatus (head frame) that securely attaches with screws to the patient's skull
- b. A body frame may be used for extracranial lesions.
- c. Provides a reference frame with coordinate system for target determination and precise patient positioning

3. Planning: CT scan, MRI, angiography, or a combination of the three may be used to define the coordinates of the volume of interest within the brain. In addition to radiation therapy personnel, a neurosurgeon is involved in SRS.

4. Steps

- a. Preparation: No shaving or special hygiene is required the day before. Laboratory studies may include creatinine levels (CT dye) and phenytoin levels.
  - b. IV access day of procedure: Depends on institution's policy
  - c. Head immobilization application/attachment
  - d. CT imaging: Used to calculate radiation dose
  - e. Treatment planning: MRI/CT images are merged together showing lesion configuration and its location near or distant from critical neurologic tissue. Planning involves selecting the number of arcs, width of arcs, and angles of the arcs.
  - f. Dose selection: Expressed in Gy
  - g. Radiosurgery treatment delivery: The number of arcs to administer will determine how long patient is in room.
- d. Collaborative management
- 1. The risk of complications following single-fraction SRS is low (3%-15%) in most reported series (Gelblum et al., 1998).
  - 2. Depends on the location, size, dose, histology, and modality
  - 3. Acute side effects (Flickinger, Lundsford, & Kondziolka, 1994; Krause et al., 1991; Shaw, Coffey, & Dinapoli, 1995)
    - a. Discomfort from the invasive, fixated head frame
    - b. Bleeding/infection at the head frame pin sites
    - c. Vertigo
    - d. Nausea/vomiting
    - e. Headache
    - f. Seizures
    - g. Fatigue
    - h. Cerebral edema
    - i. Hemiparesis
  - 4. Late effects
    - a. Persistent headaches
    - b. Asymptomatic and/or symptomatic cerebral edema
    - c. Cerebral radionecrosis
    - d. Cranial nerve deficits (cranial nerves 3-7)
    - e. Hemorrhage (Arteriovenous malformations [AVM])
    - f. Cyst formation
    - g. Changes in cognitive function
    - h. Hormonal deficiency
    - i. Alopecia
  - 5. No universal grading system specific to time course or grading of neurotoxicity for SRS currently exists (Shaw, Coffey, & Dinapoli, 1995).

- e. Patient and family education: Review procedures with the patient and family.
  - 1. Head frame placement usually is done early on the morning of treatment in the radiation or neuroradiology department by a neurosurgeon using local anesthesia (lidocaine hydrochloride). Premedication with lorazepam or diazepam may be used.
  - 2. The patient is taken to the radiology department for CT, MRI, or angiography and then returns to the radiation department or designated area to wait for the treatment planning to be finished.
  - 3. The treatment time depends on the number of isocenters and the machine delivering the radiosurgery.
  - 4. Pain medication may be used for post screw site pain or headache.
  - 5. Antiseizure medication should be administered as scheduled, and a blood level should be obtained prior to treatment. Some patients who are not already taking antiseizure medication may require a loading dose.
  - 6. Side effects will depend on size, location, and disease type. The patient may require premedication of an antiemetic and/or steroid prior to treatment.
  - 7. Inform patient and family that the head frame will be removed upon completion of therapy.
  - 8. Instruct patient and family in pin site care to prevent infection.
- f. Follow-up
  - 1. Arteriovenous malformations patients should have follow-up clinical examinations along with MRI/MRA scans at 12-month intervals until the arteriovenous malformations resolves.
  - 2. Patients with malignant tumors, including metastases and gliomas, require more frequent follow-up with both clinical and radiographic examinations.

## 2. Stereotactic radiotherapy (SRT)

- a. Procedure description
- b. Indications
- c. Treatment
  - 1. Modalities (Winston & Lutz, 1988)
    - a. Modified linear accelerator
    - b. Proton beam
  - 2. Immobilization: Uses a relocatable, custom-fitted head frame that accomplishes precise head immobilization without fixed screws into the skull. One example is a bite plate.
  - 3. Planning usually is performed using MRI image fusion technology.
- d. Collaborative management: Depends on the size, dose, and histology of tumor
  - 1. Acute effects

- a. Fatigue
  - b. Temporary alopecia
  - c. Worsening of neurologic symptoms
  - d. Seizures
  - e. Cerebral hemorrhage
  - f. Cerebral edema
- 2. Late effects
  - a. Fatigue
  - b. Hormonal imbalance secondary to pituitary/hypothalamic dysfunction
  - c. Permanent alopecia
  - d. Blindness (lesion near optic nerve/chiasm)
  - e. Stroke
  - f. Cerebral hemorrhage
  - g. Cranial nerve damage
  - h. Cerebral radionecrosis
- e. Patient and family education
  - 1. Prepare patient for specified head immobilization device.
  - 2. Inform patient and family that verification measurements, port films, and stereotactic CT require more time than standard RT planning.
  - 3. Review the same teaching as SRS.

#### H. Total body irradiation

- 1. Procedure description (Refer to the original guideline document for details)
- 2. Indications (Refer to the original guideline document for details)
- 3. Treatment: Initially, TBI was given as a single fraction of 8-10 Gy. Advancements in research during the last 25 years have shown that fractionated radiation allows higher doses to be given safely, as well as improve long-term survival (Gopal et al., 2001; Leiper, 1995; Thomas et al., 2001). Total doses and fractionation schedules of TBI vary among institutions and depend on the protocol and type of hematopoietic stem cell transplant (HSCT) the patient will receive.
  - a. Dose: Patients undergoing TBI receive a total dose of 12-15 Gy over the course of three to six days at 1.5-2.0 Gy per dose (Lawton, 2003; Wujcik & Price, 2000).
  - b. Frequency: Patients will be treated once, twice, or three times daily, depending on the treatment protocol (Bruner et al., 1998). The minimum time between fractions each day is five to six hours, and the maximum time is eight hours (Bruner et al., 1998).
  - c. Position: TBI treatment is administered while the patient is standing on a special platform, lying on a treatment table or couch, or sitting on a bicycle. Radiation is given either anteroposterior-posteroanterior (AP/PA) or by parallel opposed lateral techniques (Bruner et al., 1998; Lawton, 2003).
  - d. Time: Treatment times range from 20-30 minutes per treatment depending on the dose rate of the machine. The most common dose rates in use today are 0.05-0.2 Gy/min. (Lawton, 2003).
  - e. Pediatric consideration: Given the treatment time involved, small children may require sedation or anesthesia during the

- treatment (Bruner et al., 1998). If anesthesia is not used, provide for safety with appropriate immobilization devices.
- f. Shielding: Selective organ shielding using thin lead shields is used to reduce the incidence of long-term toxic effects after TBI, especially of the lungs. Selective shielding of the liver and kidneys also is done at some institutions. In lateral technique, the patient's arms are used to shield the lungs (Lawton, 2003).

#### 4. Collaborative management

- a. Acute effects (up to 90 days after HSCT) caused solely by TBI are difficult to isolate, as TBI is given in tandem with conditioning chemotherapy and the actual transplant procedure. Most of the side effects have multiple causes (Ford & Ballard, 1988; Lawton, 2003; Wujcik & Price, 2000).
  - 1. During TBI treatment
    - a. Fever
      - i. Onset: Immediate
      - ii. Duration: 24 hours
      - iii. Treatment: Acetaminophen
    - b. Nausea and vomiting
      - i. Onset: Immediate
      - ii. Duration: Three to five days
      - iii. Treatment: Antiemetics such as ondansetron, administered before treatment with/without dexamethasone (Decadron®) (Merck, West Point, PA) have proved to be effective (Abramovitz & Senner, 1995).
    - c. Parotitis--Pain in the postauricular region that affects the jaw. The cause of the discomfort is swelling in the parotid glands (Bruner et al., 1998; Ford & Ballard, 1988; Lawton, 2003; Wujcik & Price, 2000).
      - i. Incidence: 50% of all patients experience discomfort (Bruner et al., 1998).
      - ii. Onset: 12-48 hours after the initial dose of TBI
      - iii. Duration: 24-72 hours
      - iv. Treatment: Steroids and mild analgesics
    - d. Headache--Global headache during TBI treatment
      - i. Incidence: Approximately 33% (Bruner et al., 1998)
      - ii. Onset: Variable
      - iii. Duration: Variable
      - iv. Treatment: Mild analgesic medications, although some patients may require narcotics to relieve the pain. Narcotics must be administered with care if the protocol calls for the patient to be treated while standing (Bruner et al., 1998).
    - e. Xerostomia--Dryness of the mouth
      - i. Incidence: Almost 100% (Bruner et al., 1998)

- ii. Onset: Two to three days
    - iii. Duration: Variable, may persist long after treatment is completed
    - iv. Treatment: Establish an oral hygiene program during the transplant period using oral moisturizers, and reinforce the importance of following the program (Yeager et al., 2000).
    - v. Prophylaxis: Dental consult prior to the start of TBI and ongoing dental care, including fluoride treatments (Ford & Ballard, 1988; Sitton, 1997)
  - f. Diarrhea
    - i. Incidence: 33%-50% of all patients experience some degree of diarrhea (Bruner et al., 1998).
    - ii. Onset: Three to five days; may develop as late as two weeks after TBI is completed (Ford & Ballard, 1988).
    - iii. Duration: Usually three to five days
    - iv. Treatment: Antispasmodics or antidiarrheals are effective but cannot be initiated until infectious causes of diarrhea (e.g., *C. difficile*) have been ruled out (Bruner et al., 1998).
  - g. Fatigue--Decrease in energy level and inability to concentrate
    - i. Onset: Three to four days
    - ii. Duration: Variable
    - iii. Treatment: Energy-conserving strategies
  - h. Skin reaction--Generalized erythema
    - i. Onset: Immediate
    - ii. Duration: Three to four days
    - iii. Treatment: Prescribed cream should be applied to the entire body only at night during the TBI treatment days. Examples of creams used for radiation skin reactions:
      - Aquaphor®
      - Biafine®
      - Eucerin®
      - Jeans Cream® (Jeans Cream, Peabody, MA)
      - RadiaPlex Rx™ Gel (MPM Medical, Irving, TX)
2. During transplant course (Bruner et al., 1998)
- a. Skin reaction--Tanning/hyperpigmentation of the entire skin. Some patients will experience severe skin changes associated with acute graft versus host disease (GVHD).
    - i. Onset: 4-10 days

- ii. Duration: Variable--Begins to resolve within two weeks after TBI is complete, unless secondary to GVHD.
  - iii. Treatment: Prescribed cream should be applied to the entire body twice a day after TBI is completed.
- b. Oral mucositis
  - i. Onset: 4-10 days
  - ii. Duration: 21-28 days--Worsens during days 10-14 after TBI (O'Connell, 2000). Resolution often is associated with the recovery of the absolute neutrophil count (ANC) (Wujcik & Price, 2000).
  - iii. Treatment
    - Meticulous oral hygiene program during the transplant period. Many studies have examined various agents in addressing the incidence of stomatitis, but as of yet, no agent has shown a statistically significant advantage over another in the treatment of stomatitis. Armstrong (1994) reviewed several studies (Beck, 1990; DeWalt, 1975; DeWalt & Haines, 1969; Ginsberg, 1961), which agree that the frequency of oral hygiene should be based on the severity of symptoms. Beck (1990) recommended oral hygiene every four hours for prevention, every two hours for mild stomatitis, and every one to two hours for severe mucositis. Reinforce the importance of following the program to patient and family (Armstrong, 1994; Yeager et al., 2000).
    - GM-CSF mouth rinses: Bez et al. (1999) tested the efficacy of a GM-CSF mouth rinse in reducing the duration of severe oral mucositis in a prospective open trial. No statistical difference was noted in mucositis scores between study and control groups, but the duration of severe mucositis was reduced. Sixty percent of the GM-CSF mouth rinse group had severe mucositis for less than nine days versus 28% in the control group. In addition, only 10% of the GM-CSF mouth rinse group

experienced severe mucositis lasting 20+ days, whereas 34% of the control group had severe mucositis lasting 20+ days. Bez et al. (1999) suggested that GM-CSF mouth rinses may reduce the duration of severe mucositis, but a controlled, double-blind clinical trial is now required.

- iv. Prophylaxis: Helium-neon laser applications. Cowen et al. (1997) did a double-blind randomized trial looking at prophylactic use of helium-neon laser applications performed on day -5 to -1 on five anatomic sites of the oral mucosa, with oral examination performed daily from day 0 to +20. They showed a statistically significant improvement in the daily mucositis index ( $p < 0.05$ ) from day +2 to +7, and the cumulative oral mucositis score was significantly reduced ( $p = 0.04$ ) in patients receiving laser treatment. Occurrence and duration of grade III mucositis was reduced ( $p = 0.01$ ). Oral pain assessed by the patient was reduced as evidenced by decreased need for morphine ( $p = 0.05$ ). Xerostomia ( $p = 0.005$ ) and ability to swallow ( $p = 0.01$ ) were improved. They concluded the laser treatment was well tolerated, was feasible, and reduced oral mucositis in all cases.
- c. Alopecia: Hair loss is usually complete (Reeves, 2000).
  - i. Onset: 7-14 days after TBI
  - ii. Duration: 3-6 months after end of treatment
  - iii. Treatment: Scarves, hats, wigs as indicated by patient preference
  - iv. Education/symptom management
- d. Acute GVHD syndrome--Mainly associated with allogeneic transplants. Immunologically competent cells in the graft target antigens in the host, stimulating an immune reaction (Alcoser & Burchett, 1999). Overall incidence is 25%-70% despite GVHD prophylaxis (O'Connell, 2000).
  - i. Skin (Alcoser & Burchett, 1999; Bruner et al., 1998)
    - Maculopapular rash (pruritic or painful) starts on palms and soles and progresses to cheeks, neck, and trunk.
    - Generalized erythroderma

- Desquamation and bullae
- ii. GI tract (O'Connell, 2000)
  - Anorexia (early)
  - Nausea and vomiting (early)
  - Profuse diarrhea (several liters/day)
  - GI bleeding
  - Crampy abdominal pain
- iii. Ileus (Alcoser & Burchett, 1999; Chou et al., 1996)
- iv. Liver
  - Elevated liver enzymes
  - Liver tenderness
  - Hepatomegaly
  - Jaundice
- v. Risk factors of acute GVHD (Alcoser & Burchett, 1999; O'Connell, 2000)
  - Degree of major histocompatibility
  - Older age of recipient
  - Prior donor transfusions
  - Disease stage
  - Sex mismatching of donor and recipient
- vi. Onset of acute GVHD: Day 7--Median is day 17 posttransplant (O'Connell, 2000)
- vii. Duration: Variable up to 100 days (O'Connell, 2000)
- viii. Treatment
  - Cyclosporine (Alcoser & Burchett, 1999)
  - Tacrolimus (Alcoser & Burchett, 1999)
  - Methotrexate (Alcoser & Burchett, 1999)
  - Antithymocyte globulin (Alcoser & Burchett, 1999)
  - Corticosteroids (Alcoser & Burchett, 1999)
  - Gut rest/hyperalimentation
  - Fluid and electrolyte management
  - Pain control
  - Skin care for patient comfort and prevention of infection
  - Prevention and treatment of infections (e.g., perineal care, handwashing, isolations)
  - Octreotide acetate to decrease secretory diarrhea
- ix. Prophylaxis (O'Connell, 2000)
  - Cyclosporine
  - Procarbazine
  - Tacrolimus
  - Methotrexate

- Corticosteroids
  - T cell depletion of donor stem cells--Lessens the ability of donor T cells to recognize the host tissues as foreign (Alcoser & Burchett, 1999).
- e. Neutropenia--Potential for infection. Common sites for infection are the oral cavity, GI tract, skin, and catheter sites.
- i. Onset: 7-10 days after chemotherapy initiated
  - ii. Duration: 2-4 weeks (Alcoser & Burchett, 1999)
  - iii. Prophylaxis
    - High-efficiency particulate air (HEPA) filter or laminar flow rooms
    - Neutropenic precautions
  - iv. Treatment
    - Management of infections based on causative factor
      - Antibiotics
      - Antivirals
      - Antifungals
    - Colony-stimulating factors (CSFs) to shorten the period of myelosuppression (Whedon & Roach, 2000)
      - Granulocyte-colony-stimulating factor (GCSF)
      - Filgrastim-GM-CSF--Sargramostim
- f. Veno-occlusive disease (VOD) is a life-threatening complication of the conditioning regimen in the transplant setting, where there is luminal narrowing or occlusion in hepatic venules or small sublobular veins causing liver damage. The overall risk of development is 10%-60%. It is fatal in approximately 33% of patients affected (Lawton, 2003).
- i. Signs and symptoms (Bruner et al., 1998)
    - Right upper quadrant pain
    - Hepatomegaly
    - Liver tenderness
    - Rapid development of ascites
    - Weight gain/fluid retention
    - Jaundice
    - Coagulation abnormalities
    - Elevated liver enzymes
  - ii. Onset: One to four weeks after treatment (Bruner et al., 1998)
  - iii. Duration: Variable
  - iv. Treatment
    - Maintain fluid and electrolyte balance.

- Low molecular weight heparin therapy (100 units/kg/day) with prostaglandin E1 (dose range: 0.075-0.5 microgram/kg/h) by continuous IV infusion (Schlegal et al., 1998)
- Manage symptoms supportively.
- v. Prophylaxis
  - Fractionated radiation doses
  - Partial organ shielding of liver at doses greater than 12 Gy in 6 fractions (Lawton, 2003)
  - Low molecular weight heparin by continuous infusion therapy (Rosenthal et al., 1996)
- vi. Education/symptom management: Ascites (Walczak & Heckman, 2000)
- g. Renal toxicity (Ford & Ballard, 1988; O'Connell, 2000)
  - i. Risk factors
    - Chemotherapy
    - Radiation
    - Antibiotics
    - Cyclosporine
  - ii. Onset: Within 30 days
  - iii. Duration: Variable
  - iv. Treatment is dependent on etiology
    - Diuretics
    - Volume replacement
    - Correct electrolyte imbalances
    - Reduce nephrotoxins
    - Hemodialysis
  - v. Prophylaxis: Selective renal shielding during TBI (Lawton, 2003)
- h. Lung toxicity--Occurs in 40%-60% of patients after HSCT (Lawton, 2003; O'Connell, 2000)
  - i. Types
    - Pulmonary edema--Associated with fluid overload
    - Pulmonary hemorrhage--Associated with infection and thrombocytopenia
    - Pneumothorax--Associated with high-dose steroids, TBI, and poor nutrition with recent weight loss
    - Interstitial pneumonitis--Considered the dose-limiting toxicity for TBI
      - Idiopathic
      - Bacterial
      - Viral--Cytomegalovirus or herpes

- Fungal--Aspergillus, Candida, or Cryptococcus
  - Opportunistic--Pneumocystis carinii pneumonia
- ii. Risk factors (Lawton, 2003; O'Connell, 2000)
  - Development of GVHD
  - Pretransplant mediastinal radiation
- iii. Onset: 30 days-2 months
- iv. Duration: Up to 100 days
- v. Treatment: Based on causative factor
  - Antibiotics
  - Antifungals
  - Antivirals
  - Steroids
  - Supportive respiratory care
- vi. Prophylaxis (Lawton, 2003)
  - Lung shielding during TBI
  - Radiation fractionation during TBI
  - Trimethoprim-sulfamethoxazole (Morgan et al., 1996)
- i. Acute leukoencephalopathy--The white matter of the brain is damaged in the posterior cerebral hemispheres, characterized by cerebral edema. Incidence is unknown, but it is being increasingly reported in the literature (Moore, 2003).
  - i. Risk factors (Moore, 2003)
    - High-dose chemotherapy
    - Cranial irradiation
  - ii. Signs and symptoms
    - Lethargy
    - Somnolence
    - Personality changes with possible progression to dementia and coma (Bruner et al., 1998)
  - iii. Onset: Variable
  - iv. Treatment
    - Ventriculoperitoneal shunt, if indicated
    - Supportive care
      - Control elevated blood pressure.
      - Control fluid retention.
      - Manage infection (Moore, 2003).
- b. Late effects (generally occur 100 days after HSCT)
  - 1. Gonadal dysfunction
    - a. Females
      - i. Risk factor: Radiation
      - ii. Incidence: 95%-100% of women over the age of 18 who undergo TBI will experience early menopause and primary ovarian

failure, resulting in sterility (Abramovitz & Senner, 1995; Bruner et al., 1998; Nims & Strom, 1988). The potential for recovery of ovarian function is age dependent. Eighty percent of premenarchal females at the time of transplant ultimately achieve menarche. Postmenarchal females younger than 18 years of age at time of transplant are likely to recover sufficient ovarian function to resume menstruation (Lawton, 2003; O'Connell, 2000).

- iii. Treatment: Cyclic oral or transdermal hormonal replacement is used to reduce symptoms of premature menopause and prevent long-term disorders, such as osteoporosis and vaginal atrophic changes. (This is contraindicated in hormone-sensitive tumors.) (Bruner et al., 1998)
- iv. Education/symptom management
  - Managing symptoms of menopause (Goodman, "Managing the symptoms of menopause," 2000)
  - Osteoporosis--Maximizing bone health (Goodman, "Managing the health of your bones, 2000).
  - Vaginal dryness (Bruner & Iwamoto, 1999)
  - Vaginal stenosis

b. Males

- i. Risk factor: Radiation
- ii. Incidence: Most men who undergo TBI will maintain production of testosterone and luteinizing hormone, but 95%-100% will become azoospermatic, resulting in sterility (Abramovitz & Senner, 1995; Bruner et al., 1998; Nims & Strom, 1988).
- iii. Treatment--None
- iv. Management--Discuss option of sperm banking prior to HSCT if prior therapy has not altered sperm production.

2. Thyroid dysfunction--30%-60% of patients treated with TBI experience thyroid dysfunction.

a. Types

- i. Subclinical compensated hypothyroidism is noted by elevated thyroid-stimulating hormone in the presence of normal thyroxine levels.
- ii. Clinical noncompensated hypothyroidism (O'Connell, 2000)

b. Onset: Three months to two years after transplant (Bruner et al., 1998)

- c. Management: Baseline blood levels should be obtained prior to TBI. Thyroid levels then should be monitored on an ongoing basis.
  - d. Treatment (Lawton, 2003; O'Connell, 2000)
    - i. Asymptomatic patients may not require treatment.
    - ii. Symptomatic patients require thyroid replacement.
- 3. Growth and development impairments in children
  - a. Risk factors--Related to age when child is exposed (Abramovitz & Senner, 1995)
    - i. Cranial/craniospinal irradiation prior to TBI
    - ii. Radiation doses given during TBI
    - iii. Chemotherapeutic agents used in conditioning
  - b. Symptoms
    - i. Diminished growth (skeletal bones and lower third of face)
    - ii. Dental abnormalities (arrested root development and enamel dysplasia) in children treated before the age of six (Bruner et al., 1998; Leiper, 1995; Moore & Hobbie, 2000; Sanders, 1990)
    - iii. Delayed or arrested puberty (60% male/65% female) (O'Connell, 2000)
    - iv. Abnormal gonadotropin levels
    - v. Minor abnormalities in intelligence quotient noted at one year post-HSCT with recovery noted within three years (Chou et al., 1996; O'Connell, 2000).
    - vi. Decreased measurement of academic achievement has been noted in 7% of children who have had prior whole-brain radiation (Sanders, 1990).
  - c. Treatment (Sanders, 1990)
    - i. Growth hormone replacement
    - ii. Sex hormone replacement
  - d. Management
    - i. Physical evaluation at regular intervals using growth charts to evaluate growth development in pediatric patients
    - ii. Neuropsychological evaluations at regular intervals to evaluate the cognitive effects of children who have undergone TBI (Bruner et al., 1998)
- 4. Cataracts
  - a. Risk factors
    - i. Pretransplant cranial irradiation
    - ii. High instantaneous dose rate of radiation given during TBI
    - iii. Steroids used in treating GVHD (Belkacemi et al., 1996; Benyunes et al.,

- 1995) in multivariate analysis and retrospective studies
- b. Onset: 6 months-11 years post-TBI (Benyunes et al., 1995)
- c. Treatment: If vision is significantly impaired, then extracapsular cataract extraction with or without intraocular lens implantation
- d. Prophylaxis
  - i. Fractionated radiation doses during TBI (Benyunes et al., 1995). Incidence drops to 10% with fractionated radiation (Thomas et al., 2001).
  - ii. Heparin (prophylactic treatment for veno-occlusive disease) offers protection from cataract genesis in both uni- and multivariate analyses in a retrospective study (Belkacemi et al., 1996).
- e. Teaching: Instruct patients that their eyes will not be shielded during TBI because the eye is a potential site of relapse.
- 5. Dry eye syndrome (Sicca syndrome)
  - a. Onset: Variable
  - b. Treatment
    - i. Artificial tears to alleviate discomfort
    - ii. Protective eye ointment at night
    - iii. Surgery to ligate canaliculi that normally drain the lacrimal fluid (O'Connell, 2000)
- 6. Avascular necrosis (bone softening) (O'Connell, 2000)
  - a. Risk factor: Steroids used in treating GVHD
  - b. Onset: 2 months-10 years after HSCT
  - c. Treatment
    - i. Joint replacement
    - ii. Physical therapy
- 7. Chronic pulmonary complications: Late interstitial pneumonitis (O'Connell, 2000)
  - a. Risk factor: Chronic GVHD
  - b. Onset: Three months to two years post-transplant
  - c. Signs and symptoms
    - i. Coughing
    - ii. Wheezing
    - iii. Dyspnea resulting in decreased ability to perform activities of daily living
  - d. Treatment
    - i. Bronchodilators
    - ii. Immunosuppressive therapy
    - iii. Energy conservation techniques
  - e. Prophylaxis: Trimethoprim-sulfamethoxazole
- 8. Restrictive pulmonary disease evidenced by decreased pulmonary function tests (Bruner et al., 1998)
  - a. Onset: Six months to two years post-transplant
  - b. Treatment

- i. Asymptomatic--Follow with pulmonary function tests at regular intervals
  - ii. Symptomatic: Bronchodilators
- 9. Obstructive pulmonary disease (O'Connell, 2000)
  - a. Onset: 3-12 months
  - b. Risk factor: Chronic GVHD
  - c. Treatment
    - i. Glucosteroids alone or with cyclosporine
    - ii. Does not respond to bronchodilators
- 10. Neurologic complications (O'Connell, 2000)
  - a. Risk factors
    - i. Intrathecal chemotherapy
    - ii. Cranial irradiation
    - iii. Infections
    - iv. Systemic chemotherapy
    - v. Chronic GVHD
  - b. Leukoencephalopathy--Incidence is 7% in patients treated with TBI (Bruner et al., 1998).
  - c. Chronic neurologic changes in cognitive function (Bruner et al., 1998)
    - i. Impaired short-term memory
    - ii. Shortened attention span
    - iii. Impaired verbal skills months to years after transplant
    - iv. Difficulty learning new skills
  - d. Management
    - i. Supportive care
    - ii. Prevention and treatment of infections
    - iii. Referral for neurologic evaluation
- 11. Secondary malignancies (O'Connell, 2000)
  - a. Post-transplantation lymphoproliferative disorders, such as non-Hodgkin's lymphoma
    - i. Incidence is 0.6% (Lawton, 2003).
    - ii. Onset--Within months
    - iii. Risk factors
      - T cell depleted marrow
      - Human leukocyte antigen (HLA) mismatch donor
      - Underlying diagnosis of primary immunodeficiency
    - iv. Treatment
      - Interferon alpha
      - Intravenous immunoglobulin
      - Monoclonal antibodies
  - b. Solid tumors
    - i. Onset: 2-15 years post- HSCT
    - ii. Common diseases
      - Head and neck (O'Connell, 2000)
      - Breast (Bruner et al., 1998)
      - Lung (Bruner et al., 1998)
      - Squamous cell carcinomas (O'Connell, 2000)
      - Melanomas (O'Connell, 2000)

- iii. Treatment: Appropriate chemotherapy or radiation
  - c. Hematopoietic disorders
    - i. Types
      - Myelodysplastic syndrome
      - Leukemia (incidence is low) (Lawton, 2003)
    - ii. Treatment: chemotherapy and allogeneic HSCT
- 12. Graft rejection (O'Connell, 2000)
  - a. Types
    - i. Primary rejection: Absence of signs of engraftment
    - ii. Late rejection: Graft loss after initial signs of engraftment
  - b. Treatment
    - i. Administer hematopoietic growth factors.
    - ii. Second transplant
- 13. Relapse--Disease still present in host cells (O'Connell, 2000). Treatment consistent of
  - a. Second transplant
  - b. Standard or low-dose chemotherapy and radiation
  - c. Clinical trials
- 5. Patient and family education (Refer to the original guideline document for details)
- 6. Follow-up
  - a. Autologous and syngeneic (Wujcik & Price, 2000)
    - 1. After discharge post-transplant, patients are seen in the home or bone marrow clinic twice daily for the first four to six weeks, with support from home health nurses, and readmission for management of complications, as indicated.
    - 2. Visits are tapered to monthly as patients improve. They are followed for minimum of 90 days, or longer depending on the continuation of transplant side effects.
    - 3. Follow-up visits are scheduled quarterly for the first two years, alternating between hematology oncologist and primary care physician. The majority of patients do not have continued follow-up with the radiation oncologist.
    - 4. After the first two years, follow-up visits are extended to every six months for the next three years, then yearly.
  - b. Allogeneic (Wujcik & Price, 2000)
    - 1. After discharge post-transplant, patients are seen in the bone marrow clinic one to two times daily, tapering to two to three times weekly for the first four weeks, with frequent support from home health nurses. Visits are adjusted based on the length of time post-transplant and the stability of the patient (Wujcik & Price, 2000).
    - 2. Visits are tapered to weekly for several weeks, then every other week for several weeks. Patients extend to monthly visits, depending on their immunosuppressive

therapy taper schedule and GVHD issues. They are followed for a minimum of six months, or longer depending on the continuation of transplant side effects.

3. Follow-up visits are quarterly for the first two years, alternating between hematology oncologist and primary care physician. The majority of patients do not have continued follow-up with the radiation oncologist.
4. After the first two years, follow-up visits are extended to every six months for the next three years, then yearly.

#### I. Total nodal irradiation (TNI)

1. Procedure description (Refer to the original guideline document for details)
2. Indications (Refer to the original guideline document for details)
3. Treatment
  - a. Transplant setting
    1. Dose: Patients receive a total dose of 15-20 Gy over the course of four to five days, using hyperfractionated or accelerated hyperfractionated doses to increase cell kill and decrease late toxicity by shortening the period of myelosuppression. Patients are treated twice per day; the minimum time between fractions is six hours (Yahalom et al., 1993).
    2. If there is bulky residual disease, an alternate method of treatment is to deliver a total dose of 30 Gy to the involved field, including 15 Gy to the TNI field, over the course of two weeks. Patients are treated twice per day. The minimum time between fractions is six hours. In the morning, they receive 1.5 Gy to TNI fields. In the evening, they receive 1.5 Gy to the involved field (clinically involved or enlarged lymph nodes present before chemotherapy with additional margins that include lymph nodes within the same region) (Cox, Ha, & Wilder, 2003). This is based on patterns of treatment failure that indicated nodal sites initially involved with disease are at high risk for relapse, and radiation can reduce the incidence (Yahalom, 2000).
    3. Position: Treatment is administered AP/PA, with each treatment taking approximately 15-20 minutes to administer. Patient is supine, usually with arms akimbo (Cox, Ha, & Wilder, 2003).
  - b. Conventional setting (used in selected situations only)
    1. Dose: Each field (mantle, para-aortic with spleen, inverted Y) is treated separately to a total dose ranging from 24-36 Gy. Conventional fractionation is used, and patients receive 1.5-1.8 Gy per day. Approximately four weeks are needed to deliver the treatment to each field; patients generally are given a two- to four-week break between each field (Bruner et al., 1998).

2. Position: Treatment is administered anteroposterior-posteroanterior, with each treatment taking approximately 10 minutes to administer.

4. Collaborative management

- a. Acute side effects during TNI treatment

1. Fatigue--Most patients report a decrease in energy level after TNI (Bruner et al., 1998).

- a. Onset: During first week

- b. Duration: 6-18 months after TNI is completed (Sitton, 1997)

- c. Treatment: Energy-conserving strategies

- i. Encourage activities at time of day when patient has the least fatigue.

- ii. Prioritize, delegate, and pace activities.

- iii. Encourage short rest periods after major activities.

- iv. Increase amount of sleep at night.

- v. Encourage moderate exercise.

2. Skin reaction--Patients experience mild to moderate erythema, possibly with tanning (hyperpigmentation) of the skin. Skin reaction will be most severe in the axilla and inguinal area (Sitton, 1997).

- a. Onset: Two weeks

- b. Duration: Begins to resolve within two weeks after TNI is completed

- c. Treatment: Prescribed cream should be applied to the treated area twice a day.

- d. Instruct patient to avoid applying cream during the four hours immediately prior to radiation.

- Some examples of creams used for radiation skin reactions:

- i. Biafine®

- ii. Aquaphor®

- iii. Radiaplex Rx™ Gel

- iv. Eucerin®

- v. Jeans Cream®

3. Myelosuppression

- a. Risk factors

- i. Radiation given to the lymph system decreases the number of circulating T lymphocytes (Bruner et al., 1998).

- ii. Myelosuppression also is the result of treating bone marrow in the sternum, spine, and pelvis.

- b. Onset: Variable

- c. Duration: May last for more than one year (Sitton, 1997)

- d. Treatment: G-CSF administered during subdiaphragmatic irradiation after mantle irradiation significantly increases the white blood count and absolute neutrophil count (Sitton, 1997).

4. Xerostomia--Most patients will experience some dryness of the mouth with altered taste sensation during TNI. The degree depends on the total dose of radiation and the volume of salivary glands included in the treatment field (Bruner et al., 1998; Sitton, 1997).
  - a. Onset: First week
  - b. Duration: Variable, may persist long after treatment is completed
  - c. Treatment: Establish an oral hygiene program during the transplant/mantle radiation period using oral moisturizers, and reinforce the importance of following the program (Yeager et al., 2000).
  - d. Prophylaxis: Dental consult prior to the start of TNI and ongoing dental care, including fluoride treatments (Bruner et al., 1998; Ford & Ballard, 1988; Sitton, 1997)
5. Nausea and vomiting--Approximately 90% of patients treated with TNI will experience some degree of nausea and vomiting (Sitton, 1997).
  - a. Onset: May be immediate
  - b. Duration: Variable
  - c. Treatment: Antiemetics, such as ondansetron, administered before treatment with/without dexamethasone have proved to be effective (Abramovitz & Senner, 1995).
6. Occipital alopecia
  - a. Risk factor: Mantle radiation field that extends to mandible (Sitton, 1997)
  - b. Onset: Two to three weeks after beginning mantle field
  - c. Duration: Three to six months
  - d. Education: Educate patient that hair loss is inevitable but is temporary the majority of the time. If patient's hair is short, he or she may wish to grow hair longer in back to cover area of alopecia.
7. Esophagitis/mild dysphagia (Sitton, 1997)
  - a. Risk factor: Radiation to mantle field
  - b. Onset: Two weeks
  - c. Duration: Begins to resolve within two weeks after mantle field irradiation is completed
  - d. Treatment: Administer analgesics/narcotics based on severity of discomfort.
- b. If TNI is given in transplant setting
  1. Stomatotoxicity--Mucositis tends to worsen during the first two weeks after TNI and resolve completely within three to four weeks (Bruner et al., 1998).
    - a. Onset: First two weeks
    - b. Duration: Three to four weeks
    - c. Treatment: Establish an oral hygiene program during the transplant period. Multiple studies have examined the use of various agents in

addressing the incidence of stomatitis, but as of yet, no agent has shown a statistically significant advantage over another in the treatment of stomatitis. The studies all agree that the frequency of oral hygiene should be based on the severity of symptoms (Armstrong, 1994; Yeager et al., 2000). Beck (1990) recommended every four hours for prevention, every two hours for mild stomatitis, and every one to two hours for severe mucositis. Reinforce the importance of following the program to patient and family.

## 2. Lung toxicity

### a. Noninfectious idiopathic pneumonitis

- i. Incidence: 11%-26% of patients receiving TNI will experience pneumonitis within the first month (Bruner et al., 1998).
- ii. Risk factors
  - Prior chemotherapy with lung toxicities (e.g., bleomycin, nitrogen mustard, doxorubicin) (Bruner et al., 1998)
  - Bulky mediastinal disease (volume of lung in the field) (Bruner et al., 1998)
  - Boost irradiation to the mediastinum (total dose of radiation and fractionation) (Bruner et al., 1998; Sitton, 1997)
- iii. Prophylaxes
  - Hyperfractionated radiation doses decrease risk of pulmonary toxicity (Yahalom et al., 1993).
  - Smoking cessation
- iv. Treatment
  - High-dose corticosteroids
  - Administration of growth factors to decrease engraftment time (Yahalom et al., 1993)

### b. Pulmonary hemorrhage

- i. Risk factors: Patients with bulky mediastinal disease are at higher risk for developing spontaneous bleeding into the lung due to increased capillary permeability and alveolar leakage (Bruner et al., 1998; Sitton, 1997).
- ii. Prophylaxis: Hyperfractionated radiation doses decrease risk of pulmonary toxicity (Yahalom et al., 1993).
- iii. Treatment
  - High-dose corticosteroids
  - Administration of growth factors to decrease engraftment time (Yahalom et al., 1993)

- c. Late effects
  - 1. Sepsis (Sitton, 1997)
    - a. Risk factors
      - i. Splenectomy or splenic irradiation
      - ii. Modified production of specific antibodies
      - iii. Modified immunologic responses
    - b. Prophylaxes
      - i. Pneumococcal pneumonia vaccination prior to start of treatment
      - ii. Haemophilus influenzae vaccination prior to start of treatment
      - iii. Prophylactic antibiotics prior to invasive procedures
  - 2. Herpes zoster (shingles)
    - a. Incidence: 15%-20% of patients treated for Hodgkin's disease (Gomez, 1995; Sitton, 1997)
    - b. Onset: Within one to two years after treatment
    - c. Treatment: Acyclovir
  - 3. Radiation pneumonitis develops in approximately 10% of patients treated with TNI (Bruner et al., 1998).
    - a. Risk factors
      - i. Prior chemotherapy with lung toxicities
        - Bleomycin
        - Nitrogen mustard
        - Doxorubicin
      - ii. Bulky mediastinal disease (volume of lung in the field)
      - iii. Boost irradiation to the mediastinum.
      - iv. Total dose of radiation
      - v. Fractionation dose used (Sitton, 1997)
    - b. Onset: Three months to two years post-transplant (Bruner et al., 1998)
    - c. Signs and symptoms (Sitton, 1997)
      - i. Fever
      - ii. Rapid pulse rate at rest
      - iii. Mild cough
      - iv. Wheezing
      - v. Pleuritic chest pain
      - vi. Dyspnea resulting in decreased ability to perform activities of daily living (Bruner et al., 1998; Harwood, 1999)
    - d. Treatment: Symptoms can be treated with high-dose steroids (Yahalom et al., 1993).
  - 4. Cardiotoxicity: Pericarditis
    - a. Incidence: Occurs in less than 5% of patients (Bruner et al., 1998; Mauch & Hoppe, 2003; Sitton, 1997)
    - b. Risk factors
      - i. Mantle field radiation causes dose-dependent risk.
      - ii. Age younger than 20 years at time of radiation
      - iii. Minimal prophylactic cardiac blocking

- iv. Administration of cardiotoxic chemotherapy (e.g., doxorubicin) (Sitton, 1997)
  - c. Onset: Usually 4-12 months postirradiation, may be delayed
  - d. Symptoms
    - i. Fever
    - ii. Friction rub
    - iii. Pleuritic chest pain
  - e. Treatment: Analgesics and NSAIDs
  - f. Acute myocardial infarction--Radiation doses greater than 30 Gy to proximal coronary arteries can increase the relative risk (Cox, Ha, & Wilder, 2003).
5. Gonadal dysfunction: Female
- a. Risk factors
    - i. Radiation to pelvis: Prior to TNI, premenopausal women may be offered oophoropexy, where their ovaries are moved centrally in the abdomen and then shielded (Bruner et al., 1998; Sitton, 1997). Menopausal symptoms after pelvic irradiation may occur in women older than 30 years due to scatter radiation, even after oophoropexy (Bruner & Iwamoto, 1999; Sitton, 1997).
    - ii. The combination of chemotherapy, especially alkylating agents, with pelvic irradiation can cause impaired menstrual function and infertility in women younger than 30 (Sitton, 1997).
    - iii. Management: Cyclic oral or transdermal hormonal replacement is used to reduce symptoms of premature menopause and prevent long-term disorders such as osteoporosis and vaginal atrophic changes.
6. Gonadal dysfunction: Male
- a. Risk factors
    - i. Radiation to pelvis
    - ii. Most men who undergo TNI will maintain testosterone and luteinizing hormone production, but some of them will become sterile (Bruner et al., 1998). Shielding of the testes reduces azoospermia and allows some recovery of sperm count; however, direct or scatter radiation to the gonads can result in sterility (Sitton, 1997). Sperm banking prior to treatment is an option.
    - iii. Cyclophosphamide doses can affect sperm counts. High doses may cause permanent sterility (Sitton, 1997).

- b. Management: Discuss option of sperm banking prior to TNI if previous therapy has not altered sperm production.
- 7. Thyroid dysfunction
  - a. Risk factor: Boost irradiation administered to the mediastinum before TNI (Yahalom et al., 1993)
  - b. Incidence: Approximately 60% of patients receiving TNI (Bruner et al., 1998)
  - c. Types
    - i. Subclinical compensated hypothyroidism is noted by elevated thyroid-stimulating hormone in the presence of normal thyroxine levels.
    - ii. Clinical noncompensated hypothyroidism (O'Connell, 2000)
  - d. Onset: Three months to two years post-treatment (Bruner et al., 1998)
  - e. Management: Baseline blood levels should be obtained prior to TNI. Thyroid levels will be monitored on an ongoing basis. Instruct the patient that thyroid function tests should be monitored as part of follow-up care.
  - f. Treatment
    - i. Asymptomatic--May not require treatment
    - ii. Symptomatic--Requires thyroid replacement
- 8. Lhermitte's sign may be caused by transient demyelination of the spinal cord (Sitton, 1997).
  - a. Signs and symptoms: "Electric shock-like" sensations extending into the arms and legs with neck flexion
  - b. Incidence: 10%-15% of patients receiving TNI (Gomez, 1995)
  - c. Onset: One-and-a-half to three months after mantle radiation
  - d. Duration: Two to six months
  - e. Treatment: Usually resolves without treatment (Sitton, 1997)
- 9. Second malignancies: Risk is approximately 13% at 15 years after treatment of Hodgkin's disease (Mauch & Hoppe, 2003).
  - a. Leukemia: Occurrence after treatment is rare if radiation is given alone. If a combination of radiation and alkylating chemotherapy is given, risk increases, with peak incidence four to nine years post-treatment (Sitton, 1997).
  - b. Non-Hodgkin's lymphoma: Risk is 1% at 10 years post-treatment, increasing to 4% at 20 years post-treatment (Cox, Ha, & Wilder, 2003).
  - c. Solid tumors: Account for 75% of second malignancies (Mauch & Hoppe, 2003). Most common are breast and lung cancers, with a risk period up to 20 years post-treatment.

5. Patient and family education (Refer to the original guideline document for details)
6. Follow-up
  - a. First follow-up visit is two weeks to one month after the completion of radiation or the last cycle of chemotherapy. A PET scan should be done to evaluate all known sites of disease to check for residual disease.
  - b. Follow-up visits then taper to every three months during first two years if no evidence of disease. PET scans should be done on an ongoing basis to check for recurrence.
  - c. During the next three years, patients are seen every six months.
  - d. Five years after complete remission, the interval between follow-up visits is extended to once a year.
  - e. Yearly breast exam and screening mammograms in younger women (less than 30 years of age at time of mantle field radiation) should begin within 10 years after treatment (Sitton, 1997).
  - f. Thyroid levels need to be checked on an ongoing basis (Sitton, 1997).

J. Total skin irradiation

1. Procedure description (Refer to the original guideline document for details)
2. Indications (Micaily & Vonderheid, 1997) (Refer to the original guideline document for details)
3. Treatment
  - a. There are a variety of treatments for MF that can be used alone or in combination with chemotherapy, biotherapy, RT, or photochemotherapy.
  - b. The role of total skin irradiation was first described in 1953 and historically is considered the single most effective method in treating cutaneous T cell lymphoma (CTCL) (Becker, Hoppe, & Knox, 1995).
  - c. Procedure
    1. Treatment is typically delivered via a 6 MeV electron beam, and the patient is placed in a standing position in front of the beam.
    2. A six-field treatment approach is used that encompasses the following fields: straight anterior, right posterior oblique, and the left posterior oblique.
    3. The following day, the patient receives treatment to the straight posterior, right anterior oblique, and left anterior oblique.
      - a. Patient positioning is important so folds in the skin are minimized. Typically this includes the breast, perineum, and the panniculus of obese patients.
      - b. Patients may have their hands and feet shielded during the six-field approach and then receive supplemental therapy to these sites and additionally to the scalp if warranted.

4. External or internal eye shields may be used to protect the cornea and lens.
  5. Treatment typically is delivered four days a week for 30-45 minutes over the course of six to eight weeks for a total dose of 36-40 Gy to the skin and 18-20 Gy to the hands and feet.
4. Collaborative management
- a. Acute effects
    1. Patients will experience epithelial reactions, including pruritus, erythema, dry desquamation, and moist desquamation (see section IV, C—Skin Reactions in the original guideline document).
    2. Superficial atrophy with wrinkling, telangiectasia, xerosis, and uneven pigmentation are the most common changes (Chao, Perez, & Brady, 1999).
    3. Patients may experience pain related to skin changes.
    4. Patients will experience alopecia, which is reversible in four to six months (Maingon et al., 2002).
    5. Patients will experience nail loss.
    6. At higher doses (>25 Gy), some patients may develop transient swelling of the hands, edema of the ankles, and occasionally large blisters, necessitating local shielding or temporary discontinuation of therapy (Chao, Perez, & Brady, 1999) (see section IV, C--Skin Reactions above and in the original guideline document).
    7. Patients may report an inability to sweat properly for the first 6-12 months following therapy (Kim & Hoppe, 1999).
    8. Gynecomastia also may develop; the mechanism for this is unknown (Micaily & Vonderheid, 1997).
  - b. Late effects
    1. Superficial atrophy with wrinkling, telangiectasis, xerosis, and uneven pigmentation are the most common changes (Chao, Perez, & Brady, 1999).
    2. Although rare, higher doses may cause permanent alopecia, frank poikiloderma (mottled skin appearance), skin fragility, and subcutaneous fibrosis.
5. Patient and family education
- a. Teach patient and family about the treatment procedure and the time required for the treatment each day, as well as positioning used for the treatment.
  - b. Teach patient and family that the majority of the treatment area will be exposed during the treatment, and measures will be implemented to protect the patient's privacy.
  - c. Teach male patients about the potential risk of infertility due to the dose received to the testes and options such as sperm banking (Jones et al., 2002).
  - d. Teach patient about eye rinses to minimize irritation from eye shields.

- e. Teach patient and family about the use of skin products to minimize dry pruritus and dry desquamation.
- f. Teach patient and family about skin care if blisters and/or moist desquamation should arise.
- g. Teach patient and family to elevate extremity if swelling/edema should arise.
- h. Teach patient and family about doing skin checks and to report any new lesions or changes in lesions.
- i. Teach patient and family the importance of follow-up care to assess for late effects.

6. Follow-up

- a. Patients may be seen frequently over the first few months post-treatment for skin assessments and to determine their response to treatment.
- b. Patients may be followed by the dermatologist in conjunction with the radiation oncologist.

K. Hyperthermia

- 1. Procedure description (Refer to the original guideline document for details)
- 2. Indications (Refer to the original guideline document for details)
- 3. Implementation of hyperthermia (Jones et al., 2004)
  - a. Hyperthermia techniques include superficial, regional, and interstitial heating.
  - b. Hyperthermia is a treatment that generally uses microwave or radiofrequency energy and ultrasound applicators to heat the area of the tumor.
  - c. Several approaches have been taken and applicator devices developed to deliver hyperthermia treatments. It remains a challenge to heat tumor tissue volumes uniformly and with precision using superficial, regional, and interstitial heating devices.
- 4. Treatment
  - a. Microwaves and ultrasound pass through water before entering the body. De-ionized water-filled pillows or other devices are placed around the tumor area being treated.
  - b. Hyperthermia treatments generally take about 60-90 minutes and are given once or twice weekly. When hyperthermia is combined with other treatments, such as chemotherapy or RT, additional time and scheduling are required.
  - c. Prior to the treatments, a small, plastic catheter is inserted into the tumor under local anesthesia. Instruments for determining the tumor temperature are placed inside the catheters to provide critical information during the treatment. The amount of heat then can be applied to obtain the desired tumor temperature based on this information.
  - d. Conscious sedation may be given for patient tolerance; however, patients usually are awake enough to provide critical feedback during the treatments.

5. Contraindications (Refer to the "Contraindications" field or to the original guideline document for details)
6. Collaborative management
  - a. Acute effects
    1. Burns--The most significant side effect is a thermal injury. These may be first-, second-, or third-degree burns. Typically involves a small area of redness, usually about an inch or less in diameter, and occurs in approximately 5% of all hyperthermia treatment sessions (Jones et al., 2004)
    2. Pain--Power during treatments may occur from the amount of heat directed to the treatment area. Narcotics are given during treatments, and pain usually resolves after power is turned off (see section IV, D--Pain in the original guideline document).
    3. Bleeding and infection--May occur from the insertion of the sterile catheters into tumor to monitor temperatures during treatment
    4. Dehydration--May occur from a combination of chemotherapy, RT, and hyperthermia or may be induced by the hyperthermia treatment alone. During the treatment, patients usually will become diaphoretic, flushed, and thirsty.
    5. Nausea and vomiting--May occur from a combination of chemotherapy, RT, and hyperthermia or may be induced by the hyperthermia treatment alone. Nausea and vomiting associated with this large amount of heat given in a short period of time usually will be short-term and resolve after the power is turned off and the treatment has stopped.
    6. Fatigue--May occur from a combination of chemotherapy, RT, and hyperthermia or may be induced by the hyperthermia treatment alone. The patient usually will feel "washed out" after the hyperthermia treatment and require a short nap or resting period afterward. Usually within 24 hours the patient is back to his or her baseline activities (see section IV, B--Fatigue above and in the original guideline document).
  - b. Late effects
    1. Fat necrosis--Area of subcutaneous tissue burned during treatment; may become firm and sore. Because of firmness, patient may be mistakenly alarmed of tumor recurrence. Routinely feels like a bruise. Takes weeks to months to resolve. No treatment necessary to expedite healing process.
    2. Thermal injury--Skin surface burn, third-degree burn requiring a skin graft
7. Patient and family education
  - a. Teach patient and family about treatments, including procedure and time required to receive treatments. Discuss treatment scheduling, including total time involved for hyperthermia, radiotherapy, and/or chemotherapy treatments.

- b. Teach patient and family about side effects directly from the hyperthermia treatments and the increased sensitivity heat adds to radiotherapy and chemotherapy.
- c. Teach patient and family how to recognize degree of skin burn.
- d. Teach patient and family to assess skin area and to report any new skin breakdown.
- e. Teach patient and family about the use of skin care products to minimize discomfort if burn arises.
- f. Teach patient and family to report fever, chills, redness, swelling, pain, bleeding, and drainage from skin breakdown.
- g. Teach patient and family to monitor blood counts frequently, as adding hyperthermia to existing treatment therapies may increase hematologic toxicities.
- h. Teach patient and family to take medications needed prior to hyperthermia treatments. These medications include medications for pain, nausea, and anxiety.
- i. Teach patient and family relaxation and distraction techniques to help patient tolerate anticipated treatment sessions.
- j. Teach patient and family to eat small, bland meals prior to treatment and drink plenty of liquids, including water, juices, decaffeinated beverages, and/or sports drinks with electrolytes.
- k. Teach patient and family to decrease fatigue by saving energy for more important activities; alternate activity with rest periods; use relaxation techniques; and exercise regularly.
- l. Teach patient and family the importance of follow-up care for assessment and management of side effects of treatment.

#### 8. Follow-up

- a. Patients are to be seen frequently over the first year post-treatment by surgical, medical, and radiation oncology specialties for assessment and evaluation to determine their response to treatment.
- b. Patients who have skin grafts associated with a third-degree burn will be followed by radiation oncologists and plastic reconstructive surgery specialists.

#### L. Photodynamic therapy (PDT)

- 1. Procedure description (Refer to the original guideline document for details)
- 2. Indications (Refer to the original guideline document for details)
- 3. Treatment: The sequence for a single PDT treatment covers a minimum of five days and is conducted in several stages (Sanofi Pharmaceuticals, 1997, 1999).
  - a. Day 1 involves the IV administration of Photofrin, a photosensitizing agent. The drug can be given in the outpatient setting or administered while the patient is in the hospital. The patient can eat and drink normally on the day of injection. Photosensitivity to the skin and eyes can begin within five minutes of the injection. The patient is instructed on the clothing and special precautions that must be taken during this period of photosensitivity that lasts for four to six weeks.

- b. The standard dose of Photofrin is 2 mg/kg (Sanofi Pharmaceuticals, 1996). When reconstituted, Photofrin is stable for two to four hours and must be protected from light. Photofrin is given via slow IV push over three to five minutes. Photofrin is classified as an antineoplastic agent. Although it is not a vesicant, caution should be used to prevent extravasation of the drug. The person preparing the Photofrin should wear gloves and protective eyewear to avoid contact with skin and eyes (Bruce, 2001).
- c. On day 3, the patient is ready for the light activation step of the PDT process. The patient is nothing by mouth for eight hours prior to the laser light treatment. The application of the light is performed in the OR, and the patient may receive a sedative, local anesthetic, or conscious sedation to provide comfort during the procedure. Some institutions may use general anesthesia and intubate the patient. The patient and staff are given protective eye goggles to wear during the procedure. The laser light is directed to the cancer cells through a fiberoptic guide that is passed through a scope. The instrument is positioned close to or into the tumor, and the precise amount of light is delivered. The light application takes 12½ minutes, and the entire procedure takes approximately 30 minutes to complete. Recovery is brief unless the patient had general anesthesia and intubation, when the patient will go to the surgical intensive care unit or a step-down unit for close observation of the airway.
- d. On day 5, another endoscopy or bronchoscopy is performed for the purpose of removing necrotic tissue and exudates that could cause obstruction of the airway or esophagus. This is also an opportunity to evaluate the response to the PDT. This second look procedure does not require another injection of Photofrin.

#### 4. Collaborative management

- a. Acute effects
  1. Photosensitivity is the main side effect that occurs immediately after administration of Photofrin and lasts for a minimum of 30 days. Side effects range from mild skin erythema to severe, debilitating burns (Durkin, 1999). Other side effects directly related to the administration of Photofrin include nausea, constipation, and fever (Sanofi Pharmaceuticals, 1997).
  2. Symptoms experienced post-PDT include localized swelling and inflammation to the treated area, which may cause local discomfort (Bruce, 2001).
  3. Other common symptoms include mucositis, pharyngitis, nausea/vomiting, constipation, bleeding at the site, fever, infection (pneumonia or bronchitis), dyspnea, chest pain, and dysphasia.
  4. Symptoms usually are transient and self-limiting. Most symptoms respond to conventional symptom management strategies.

- b. Late effects: There are essentially no chronic side effects from the administration of Photofrin or the PDT process (Sanofi Pharmaceuticals, 1996).
5. Patient and family education (Lightdale & Mang, 1997)
- a. Teach patient and family about Photofrin injection, side effects, photosensitivity, use of protective clothing, and strategies to protect against photosensitivity.
    - 1. Photosensitivity begins immediately after injection of Photofrin and lasts for approximately four to six weeks.
    - 2. Photofrin-induced photosensitivity reaction is characterized by swelling, redness, or blistering (Bruce, 2001).
    - 3. Protective clothing includes tightly woven, light-colored long-sleeve shirt and long pants, wide-brimmed hat, scarf, gloves, and dark sunglasses.
    - 4. Sunscreen of any sun protection factor offers no protective value against the photosensitivity.
    - 5. Avoid direct sunlight from skylights or undraped windows; patient should remain at least six feet from windows.
    - 6. Limit outdoor activities to after the sun has gone down.
    - 7. Avoid helmet-type hair dryers to prevent burns on scalp.
    - 8. Do not stay in a totally darkened room, as low levels of indoor light are necessary to help break down the Photofrin retained in the skin (photo bleaching reaction).
    - 9. Patients requiring emergency or elective abdominal surgery need to tell their surgeon that they have had PDT so that special draping and OR light filters can be used (Bruce, 2001).
    - 10. Women of childbearing age should practice effective methods of birth control during use of Photofrin and photodynamic therapy.
    - 11. Fever, nausea, and constipation related to the Photofrin responds to conventional use of antipyretics, antinausea medication, and a good bowel regimen.
  - b. Teach patient and family about the PDT procedure and recovery phase.
    - 1. Close monitoring: EKG, pulse oximetry, suction, oxygen, and IV access
    - 2. Warn patients that a burning chest pain may occur during the procedure and that analgesics will be administered to reduce the discomfort.
  - c. Teach patient and family how to test for photosensitivity on day 31.
    - 1. Have patient place his or her hand in a paper bag with a two-inch hole in it.
    - 2. Expose it to direct sunlight for 10 minutes.
    - 3. If a reaction occurs within 24 hours, continue with photosensitivity precautions for an additional two weeks, then repeat the test.

4. If no reaction occurs within 24 hours, the patient may gradually increase his or her exposure to sunlight, while continuing to watch for skin reactions.
- d. Signs and symptoms to report to the healthcare team
  1. Red or blistered skin at any point following treatment
  2. Unrelieved nausea, fever, or constipation
  3. Mucositis, pharyngitis, and dysphasia
  4. Infection
  5. Difficulty breathing and/or chest pain
  6. Bleeding
6. Follow-up
  - a. After discharge from the hospital, the patient will return initially for follow-up endoscopy or bronchoscopy one week after treatment, then monthly for three months.
  - b. The patient then has endoscopies or bronchoscopies at 6, 12, and 18 months after treatment (Kitzrow, 1992).

## Special Populations: Pediatric Radiation Oncology

- A. Pediatric radiation oncology
  1. Pediatric cancers (Refer to the original guideline document for details)
  2. Specific differences between pediatric and adult cancers
  3. Issues associated with treating children with radiation
    - a. Developmental issues--Every child is a unique person with an individual temper, learning style, family background, and pattern and timing of growth.
      1. Universal predictable sequences of growth and change occur at various ages of a child's life. Learning these various developmental stages and assessing if the child is at the appropriate age is important for the radiation oncology nurse (Ruble & Kelly, 1999).
      2. Developmental considerations in treating children with cancer (see Table 21 in the original guideline document)
    - b. Psychosocial issues--There is an enormous need for psychosocial care for the child with cancer and his or her family.
      1. 20%-40% of the physically healthy population shows moderate to severe psychosocial stress or mental disorder (Kusch et al., 2000).
      2. Certain factors may place families at risk for stresses in coping with the disease. The principal familial risk and protective factors include the following (Kusch et al., 2000).
        - a. Social support
        - b. Self-confidence
        - c. Social competence
        - d. Coherence of the family
        - e. Socio-economic factors
        - f. Psychiatric disorders

3. Enlisting the expertise of social workers, behavioral medicine, and psychology will benefit the child and family with coping skills during the course of treatment. Standardized protocols defining principles, programs, and quality psychosocial care for children with cancer and their families are called for by many researches (Kusch et al., 2000).
  4. The Manual of Psycho-Social Care in Pediatric Oncology illustrates a program of standardized basic psychosocial care provided to patients and families.
- c. Nutritional issues--Malnutrition in the pediatric oncology population has been reported to occur in 8%-32% of patients (Hanigan & Walter, 1992; Han-Markey, 2000).
1. Compared to adults, children's nutritional needs must include energy requirements for growth and development, in addition to needs required to support them during treatment of their disease. Because of their particular body composition (higher water content and decreased fat), children have decreased caloric reserves, making them susceptible to malnutrition sooner than adults.
  2. Children are dependent individuals, and often they are not responsible for preparing their own food and require the nutrition support and counseling of members of the family or caregivers. Input from a registered dietitian using established pediatric treatment in assessing, planning, and implementing a nutritional plan of care is preferable to assist in ensuring that the nutritional needs of this specialized population are met.
  3. A history of weight loss, weight for age, weight for height percentiles, along with simple subjective questions concerning appetite, number of meals consumed per day, or modified diet or supplement use can be asked by the radiation oncology nurse.
- d. Immobilization/sedation issues--One of the most challenging factors in treating children with radiation is maintaining the child in a fixed and reproducible position on a daily basis where the tumor can be targeted and normal tissue is spared (Bucholtz, 1992, 1994; Scott, Langton, & O'Donoghue, 2002).
1. Generally, children older than three years may be capable of lying still on the radiation therapy table.
  2. Younger children (< three years), developmentally disabled children, and occasionally older, anxious children may require sedation for planning and/or treatment. This challenges the physician, nurses, and technologists in choosing the correct method(s) of immobilization and sedation to be used, along with use of monitoring the child daily, and timing the actual treatment sessions.

3. It is important to allot time during the initial consultation for assessing the need for sedation. This requires the early involvement of anesthesia staff familiar with pediatric anesthesia and RT treatment. Data regarding the child's age, developmental assessment, diagnosis, present physical status, past experiences during other procedures with lying still, and type of radiation treatment will be required. The expertise of a child life specialist is very helpful with the use of play and role playing to decrease anxiety experienced by children and may prevent the need for sedation (Lew, 1997).
4. Special considerations and interventions are needed dependent upon the age of the child (Lew, 1997) (see Table 22 in the original guideline document).
5. The use of sedation agents such as chloral hydrate, meperidine, chlorpromazine, or promethazine intramuscularly is practiced at some centers as an alternative to general anesthesia. Some limitations of the agents include variability in absorption and onset of action, sub-optimal sedative effects, prolonged somnolence, and increased potential for serious adverse reactions, such as respiratory or cardiac depression when multiple drugs or high doses of medications are used. Therefore anesthesia is the better choice in treating very young children.
6. The approach to sedation and anesthesia varies with the available institutional resources. The expertise of pediatric anesthesiologists is desirable because of their knowledge and familiarity of the agents that are appropriate for children and their ability to intervene when complications occur.
7. Arrangements for early morning treatments are recommended and should be coordinated with the anesthesia department and radiation therapists.
8. Separate consents for anesthesia should be obtained by the anesthesiologist along with daily evaluation of the child's health status.
9. Parents should be instructed to withhold solid food and milk products from the child for six to eight hours prior to anesthesia and liquids two hours prior to anesthesia, depending on the anesthesiologist's recommendations.
10. A registered nurse with experience in CPR, recovery room experience, and proficiency in airway management should be available to assist the anesthesiologist.
11. An identified policy/procedure for obtaining assistance in emergencies should be in place. The use of closed-circuit television to focus directly on the child and display the monitoring device, EKG, pulse oximeter, blood pressure, and carbon dioxide analyzers are essential. All emergency equipment, including oxygen source, suction equipment, an anesthesia machine and monitoring equipment, a pediatric code cart that contains airways and endotracheal tubes of appropriate size, Ambu bags,

code drugs, and IV equipment, should be checked daily prior to initiation of treatment.

12. Continual monitoring during the recovery period is performed until the child is fully awake and vital signs are stable (Lew, 1997).

e. Late effects--Success in the treatment of childhood cancers has led to an increase in the number of long-term survivors. Unfortunately, late side effects caused from radiation treatment continue to be seen (see Table 23 in the original guideline document).

1. It is important to educate the family of these effects and to inform them that there is still research under investigation.
2. Follow-up care and counseling to the potential side effects should be discussed; information regarding prevention and early detection is essential. The objective is to provide patients with the knowledge to lead a healthy life as adults after they have survived cancer.

## Chemical Modifiers of Cancer Treatment

A. Radiosensitizers (see also section II, B--Radiobiology above and in the original guideline document)

1. Definition: Radiosensitizers are chemical or pharmacologic agents that increase radiation damage to sensitive cells when given concurrently with radiation (Wilkes, Ingwersen, & Barton-Burke, 2003).
2. Rationale: To enhance damage to tumor cells while minimizing normal tissue toxicity (Bryer, 2001)
3. Types
  - a. Hypoxic cell sensitizers (nitroimidazoles: misonidazole, etanidazole, and nimorazole) increase oxygenation of tumor cells, which contributes to DNA damage from radiation. Neurotoxicity limits the use of effective doses (Hall & Cox, 2003). Currently it is only used in clinical trials.
  - b. Non-hypoxic (aerobic) cell sensitizers (halogenated pyrimidines: bromo-deoxyuridine and iododeoxyuridine) are incorporated into the deoxyribonucleic acid (DNA) of rapidly dividing tumor cells, increasing sensitivity to radiation (Bryer, 2001; Wilkes, Ingwersen, & Barton-Burke, 2003). They are highly toxic to normal tissues as well, and side effects at effective dose levels limit use with extended RT courses (Hall & Cox, 2003). Currently they are used in clinical trials.
  - c. Hypoxic cell cytotoxic agents selectively kill hypoxic cells. Examples include tirapazamine, currently used in multiple clinical trials, and mitomycin-C, used in clinical practice (Stevens, 2003).
  - d. Chemotherapy sensitizers are in widespread use in clinical practice, singly or in combinations. The most commonly used are
    1. Fluoropyrimidines: 5-FU

2. Taxanes (docetaxel, paclitaxel), platinum compounds (carboplatin, cisplatin), etoposide (VP-16), gemcitabine hydrochloride, and bleomycin sulfate
3. Topoisomerase inhibitors: irinotecan hydrochloride, topotecan hydrochloride

#### B. Radioprotectors

1. Definition: Radioprotectors are defined as chemical modifiers designed to minimize normal tissue damage resulting from RT without compromising local tumor control (Capizzi, 1999; Kemp et al., 1996).
2. Cytoprotectants are defined as chemical modifiers designed to minimize normal tissue damage resulting from chemotherapy administration without compromising tumor control (Capizzi, 1999; Kemp et al., 1996).
3. Radioprotective agent with Food and Drug Administration (FDA) approval: Amifostine
4. Radioprotective or cytoprotective agents being investigated include the following.
  - a. Gene therapy: Intratumor injection of manganese superoxide dismutase-plasmid/liposome (SOD2-PL)
  - b. Transforming growth factor-beta
  - c. Keratinocyte growth factor (KGF)
  - d. Glutamine
  - e. IL-15
  - f. Melatonin
  - g. Omega-3 fatty acids (Jatoi & Thomas, 2002).

References open in a new window

#### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of evidence supporting the recommendations is not specifically stated for each recommendation.

#### BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

##### POTENTIAL BENEFITS

Radiation oncology nurses can help patients manage their symptoms to improve the quality of their lives during and after treatment.

##### POTENTIAL HARMS

Refer to the "Major Recommendations" section and the original guideline document for side effects of radiation therapy and to safety issues of importance to health practitioners working with patients receiving radiation therapy.

## CONTRAINDICATIONS

### CONTRAINDICATIONS

- Contraindications for enteral nutrition are a malfunctioning gastrointestinal (GI) tract, mechanical obstruction or ileus, severe GI hemorrhage, intractable vomiting or diarrhea, and high output GI tract
- Dexamethasone incompatibilities: Contraindicated with daunorubicin, doxorubicin, metaraminol, and vancomycin
- Pentosan polysulfate sodium is contraindicated in patients on anticoagulant therapy
- Cyclic oral or transdermal hormonal replacement is contraindicated in hormone-sensitive tumors.

### Hyperthermia

- Patients with widely metastatic cancer are not eligible for regional hyperthermia treatments.
- Because of the microwave and ultrasound equipment used, patients with cardiac pacemakers, orthopedic metal rods, plates, or prostheses are not eligible.
- Unstable cardiac disease, severe neuropathy, skin grafts/flaps, surgical implants or implanted devices, or pregnancy
- Inadequate blood counts

### Radioimmunotherapy and radionuclide therapy

- Patients should not receive the regimens if they have more than a 25% lymphoma marrow involvement or impaired bone marrow reserve because of the increased potential for hematologic toxicities.
- Type I sensitivity, production of human anti-mouse antibodies (HAMA), to murine proteins (mouse antibodies). The number of patients who develop HAMA seems to be directly proportional to the amount of prior chemotherapy the patient has received and his or her degree of immunosuppression.

## QUALIFYING STATEMENTS

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The guideline document was published by the Oncology Nursing Society (ONS). ONS neither represents nor guarantees that the practices described therein will, if followed, ensure safe and effective patient care. The recommendations contained in the guideline document reflect ONS's judgment regarding the state of general knowledge and practice in the field as of the date of publication. The recommendations may not be appropriate for use in all circumstances. Those who use the guideline document should make their own determinations regarding specific safe and appropriate patient-care

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## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

### IMPLEMENTATION TOOLS

Staff Training/Competency Material

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

End of Life Care  
Getting Better  
Living with Illness  
Staying Healthy

### IOM DOMAIN

Effectiveness  
Patient-centeredness  
Safety

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Oncology Nursing Society (ONS). Radiation oncology nursing practice and education. 3rd ed. Pittsburgh (PA): Oncology Nursing Society (ONS); 2005. 277 p. [1078 references]

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COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

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GUIDELINE STATUS

This is the current release of this guideline.

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#### GUIDELINE AVAILABILITY

Electronic copies: Not available at this time.

Print copies: Available for purchase from the Oncology Nursing Society, 125 Enterprise Drive, Pittsburgh, PA 15275-1214; telephone, 412-859-6100; fax, 412-921-6565. The ONS Publications Catalog is available online at the [Oncology Nursing Society \(ONS\) Web site](#).

#### AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Catlin-Huth C, Haas M, Pollock V. Radiation therapy patient care record: a tool for documenting nursing care. Pittsburgh (PA): Oncology Nursing Society; 2002.
- Haas ML (Ed.) Radiation oncology nurses enhancing excellence: site specific CD modules. Pittsburgh (PA): Oncology Nursing Society; 2006.

Ordering information is available from the [ONS E-Source Web site](#).

The following is also available:

- ONS Radiation Therapy Course

Information on this course is available from the [Oncology Nursing Society Web site](#).

#### PATIENT RESOURCES

None available

#### NGC STATUS

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